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## CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

### *On the History and Construction of Iron Lighthouses; with a Description of the Coffin's Patches Light.* By J. VAUGHAN MERRICK.

(WITH A PLATE.)

We have observed in the *Civil Engineer and Architect's Journal* for November, an article descriptive of an iron light tower, constructed for the Island of St. Isaacs, in the West Indian group, which has suggested a few remarks about iron lighthouses generally, and the different methods of using that metal in their construction.

There are few branches of mechanical industry in which the application of iron has effected so complete a revolution as in this one. The erection of lighthouses, is ordinarily a difficult, tedious, and expensive operation; not unfrequently attended with danger, or sacrifice of life to those engaged in it; and as delays in the completion of such works not only entail an increase of cost, but are likely to cause maritime loss, involving the destruction of life and property on the part of those for whose benefit they are designed; it becomes an object of high importance to reduce to a minimum, the labor required at the locations in which they are to be erected. Again, the materials have usually to be transported from a distance, and should, therefore, be as light as possible; in other words, that material, and that arrangement of form should be adopted, which combine the greatest strength with the least weight; due regard being had to the first cost and to the durability of the structure. Comparing in these particulars, the materials formerly employed, viz: stone or brick

and that which is at present used, iron; the advantages offered by the latter are so manifest, as to require no argument in their support, and seem to indicate its exclusive use in future works of the kind.

In the United States, England, and France, many iron lighthouses have already been constructed. Some of these resemble, when completed, the old fashioned stone towers, being composed of cast iron plates, bolted together by transverse and vertical flanches, so as to form when put together a conoidal shell. Others, consist of a network of piles diagonally braced, forming a polygonal structure of a form diminishing in size as it ascends. Before adducing examples of these two types, it may be well to trace a brief history of both. The first record with which we are acquainted, of the idea of employing iron for this purpose, is to be found in Vol. xxvi., p. 1, *London Mechanics' Magazine;* wherein under date of August 31, 1836, Mr. John Lake, of London, proposed to obviate the liability to destruction of lighthouses from the force of the sea, by elevating the keeper's house and lantern on a metallic column, only two or three feet in diameter, and bracing the former by a series of chains, moored at equidistant points on a large circle described from the centre of the column. How these chains were to be attached, or upon what foundation the central column was to rest, does not appear; as the idea was evidently a crude one and not worked out by its author. Subsequently, in a letter to the same *Journal*, he proposed to substitute wrought iron tension rods for the chains. About the same time, 1835-36, Mr. Alexander Mitchell, of Belfast, was experimenting with cast iron mooring screws at Bristol, England. These screws, which are undoubtedly the best form of mooring known, he proposed to make from three to four feet diameter, of one thread wound round a conical barrel, the thread enlarging spirally as it ascended from near the point of the central cone to the full diameter. The employment of such mooring screws to secure the bracing rods or chains, would have made Mr. Lake's plan feasible; but Mr. Mitchell, in August, 1838, began the erection of a lighthouse on the Maplin Sands, which must be considered the pioneer in iron lights, as it was the first one planted on a series of iron piles on the points of a polygon, which, in conjunction with a central pile, should constitute the skeleton or frame of the structure. The Maplin Sands lie at the mouth of the Thames, 20 miles below the Nore, and form the Northern side of the King's Channel. As this is frequented by the larger class of vessels bound to or from London, the position is an important one. The eight piles, arranged in an octagonal form forty feet diameter, and the central one, are all of wrought iron five inches in diameter, twenty-six feet long, shod with cast iron screws, 4 feet diameter; and were screwed into the sand until their tops were about five feet above low water mark; upon these, two years afterwards, a superstructure was raised, about 30 feet high, tapering from 40 feet diameter, up to 16 feet at the top; which is surmounted by a lantern in which a Fresnel Dioptric light, of the second order, is exhibited. The superstructure consisted of hollow iron pipes curved inwards near the top, above which were wooden uprights inclined towards their common centre, and secured together by circles of horizontal iron ties at the height of 6 and 15 feet above low water; and at the same points to the central pile by radial ties; also diagonally to the central

pile, but not diagonally together. The latter modification was first introduced into the Port Fleetwood Lighthouse, to avoid a supposed tendency to torsion of the whole when struck by the waves. The latter structure, erected in Morecambe Bay, West Coast of England, and very similar to the Maplin, was the first one *completed*, having been lighted in 1839; it was designed by Mr. Mitchell. It was placed on seven 5 inch piles, 16 feet long, with screws 3 feet diameter; and the iron is surmounted by timbers 48 feet long, supporting a lantern containing a Dioptric of the second order.

The *Screw Pile* Lighthouse, that is to say, a columnar structure supported on screws, is, therefore, the oldest known form of iron lighthouse.* Propositions have, however, been made to modify it in two ways. Dr. Potts, of England, in Dec. 1843, patented what has since been known as the Pneumatic Pile; which is a hollow cylinder of metal, closed at the top and open below, placed upon the sand desired for a foundation, and forced down by exhausting it of air.

By this method, a mooring was, in 1845, secured on Goodwin Sands for a beacon, erected by order of the Trinity Board; and the plan was subsequently adopted by several engineers in England, as a means of obtaining proper foundations for bridges, piers, &c.

In February, 1846, Mr. John de la Haye, of London, writing for the *Mechanics' Magazine*, (Vol. XLIV., p. 157,) proposed the construction of a skeleton lighthouse, by sinking six wrought iron shafts twenty feet or more in the sand by such air-tight cylinders, and at an angle inclined towards a common centre; their tops to be then united by suitable rings, and the whole to be properly braced by iron tie rods. This was, in fact, Mr. Mitchell's lighthouse, modified by the substitution of pneumatic for screw pile foundations; a substitution which seemed unnecessary, as the screws gave entire satisfaction, and were probably less expensive.

The other proposed change is, we believe, peculiar to this country, and consists in adapting the pile lighthouse to hard foundations where the screw would not enter, by pointing the piles and driving them in to the requisite depth; resting the weight of the superstructure on flat disks which surround each pile, and are placed on the foundation, leveled for the purpose.

The first erected on this plan was at Minot's Ledge Rock, about 17 miles below Boston, Mass. This was put up in 1847–8, and was swept away in a terrific gale, which occurred April 17, 1851. It was in a location exposed to the whole fury of the sea, resembling in that respect the celebrated Eddystone Rock, being within fifty feet of deep water. Its loss was principally owing to its narrow base, which was limited by the size of the area of rock on which it stood. Its height was about seventy feet, and its base twenty-five feet; the frame work was composed of nine wrought iron piles, dropped into cavities bored five feet deep in the solid

*NOTE.—It should be remarked, in this connexion, that the columnar nature of these structures is of older origin, and that an example could be seen of a wooden light house, standing and in good condition in 1852, which had been erected in a very exposed situation on the Small's Rock, off St. David's Head, in 1778, and was then 74 years old. It is 56 feet high, and was composed of nine oaken piles nearly vertical, fixed to the rock, and protected from the effect of westerly gales, by shores placed against the easterly piles.

rock. The piles tapered from 10 inches at the surface, to 8 inches diameter at the point.

The causes of the disaster at Minot's Ledge were so well understood, that it did not deter the U. S. Government from the construction of other lighthouses on the same plan.

The foregoing remarks have referred only to the Marine Lighthouse, or, in other words, those which are intended for erection on foundations covered by water; and although it is evident, that the last described plan would be applicable to either land or water, yet we must not omit to notice the other plan, designed only for land erection, referred to in the commencement of this article.

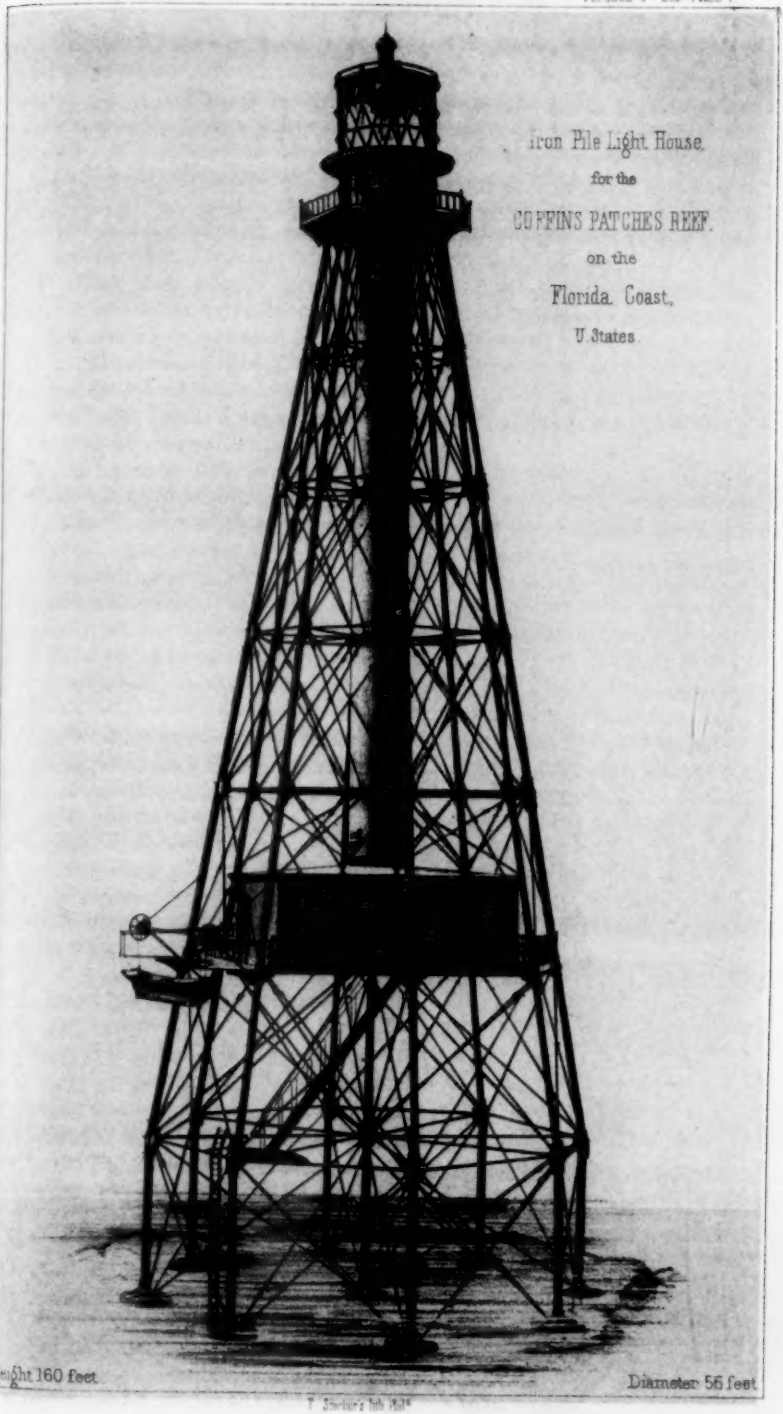
In the early part of 1841, Mr. Alexander Gordon, of London, designed and erected at Morant Point, on the eastern end of the Island of Jamaica, a lighthouse resembling in external appearance the stone structures commonly used, but made of plates of cast iron arranged in segments, and bolted together by flanches projecting inwardly. It was 18½ feet in diameter at base, 11 feet at the top, and about 100 feet high to the top of the lantern. This building having been erected at far less expense than one of stone would have been, and having for two years survived the storms and earthquakes common in that vicinity, the same gentleman was subsequently employed to erect a similar one on Gibbs' Hill, Bermuda, which was conoidal like the former, 106 feet high, surmounted by an inverted conoidal capital. The diameter at the base was 25 feet, and at the top 16 feet. About 20 feet of the lower part of this tower was filled in with concrete, in order to increase its stability. It stood on an elevation of about 245 feet above sea level.

Mr. Gordon is entitled to the credit of having first employed cast iron for large sea lighthouses, though the idea of using that material for such a purpose originated (it is believed,) with Sir Samuel Brown, R. N., and a small light tower at Gravesend Pier had been erected before the Jamaica tower was put up.

Other similar towers have, since the period above named, been erected, and it is to one of them that the description refers in the *Civil Engineer and Architect's Journal*, which suggested these remarks. We propose to quote this description, and to follow it by a brief account of the Coffin's Patches Lighthouse, of which the accompanying plate (Plate I.) is an illustration, and which is to be located within a short distance of, and in a similar situation to, that for the Isaacs. The two structures are the largest specimens of their respective types yet built, and we think that a fair and candid comparison of their merits, will show the vast superiority of the open one, and vindicate the preference given to this plan by our Government.

The following is the description referred to :—

There is now in the course of erection at the engineering works of Messrs. Grissell, Canal Basin, near the City-road, a cast iron lighthouse, the ultimate destination of which is the island of St. Isaac's, among the West Indian Islands. This lighthouse is 24 feet diameter at the base, and will rise to the elevation of 150 feet to the top of the lantern. It will diminish upwards from its lower diameter to 14 feet. The entire work is formed of a series of cast iron plates, of about 1¾ inch in thickness upon the lower courses, with radiated joints, diminishing to a thickness of ⅞-inch in the upper courses. Each joint is formed, not by the usual flanch joint, lapped and bolted, but by a description of double joint, or butt, with an interstice between, which presents a double thickness, through




T. Sinclair's 5th Plate

which the iron bolts will pass, and through which the plates are screwed together. This principle of jointing resembles the joggle joint in practical masonry, the interstice, or key, between being intended to be filled in with iron cement. There is, however, one peculiarity in the construction of this lighthouse, which consists in the arrangement of the plates, which break joint upon the horizontal bed, and therefore it is not continuous, as in ordinary structures of this description. This circumstance will necessarily occasion an undue strain to arise upon the bolts in the event of any settlement or the slightest dislocation of the plates occurring throughout the structural arrangement. The lower portion of the lighthouse, to the height of 24 or 25 feet, will be filled in with solid concrete, and will at this elevation be entered by an external staircase. The interior will have a spiral staircase ascending to the lantern, and will be filled in with store-rooms, offices, and apartments necessary for the purpose of the lighthouse. The general character of the structure is massive and imposing, and altogether in effect consistent with the purpose to which it will be ultimately appropriated. The weight of the iron work entire will approach 300 tons.—*Mining Journal.*

The American Lighthouse for Coffin's Patches, is intended to form a part of the splendid chain of lights along the dangerous coasts of the Florida Reefs, which has, for some five years past, been in course of erection by our Government,* and which, when completed, will be a lasting monument to a liberal and judicious policy in this Department. It has been constructed under the superintendence of Lieutenant George G. Meade, U. S. Topographical Engineers, assisted by Mr. John W. Nystrom, at the works of Merrick & Sons, Philadelphia. It will have the following general dimensions: height from bottom of piles to base of disks or top of rock 10 feet, from top of rock to high water level at spring tides, 10 feet; from high water level to focal plane, 137 feet; from top of rock to top of spire over lantern, 164 feet 9 inches; from top of rock to top of lantern, 160 feet; diameter at the base and up to 10 feet above high water level, 56 feet from centre to centre of piles. Diameter at the lantern or gallery floor 15 feet from centre to centre of piles; diameter of lantern, (which is of boiler plate, for a height of 8 feet up to the upper gallery,) 12 feet 6 inches; thence glazed with thick French plate glass, same diameter as below, (12 feet 6 inches,) 9 feet high, terminating in a conical top ventilator, and spire. The floor of the keeper's house is elevated 32 feet above high water; and the house itself is of boiler plate lined with wood, 30 feet square by 10 feet in height. From this house, access is had to the lantern by a cylindrical boiler plate trunk 6½ feet diameter, surrounding the central pile, and containing a spiral staircase.

The lower tier of piles are 12 inches in diameter, 30 feet long; the next tier 10 inches diameter, 22 feet long, both of wrought iron. Above the latter, the piles are hollow, of cast iron, diminishing from 12 to 8 ins. external diameter. These several tiers are connected by cast iron sockets, on which the requisite lugs are cast to receive the ends of the various braces and tie rods. The structure is braced by radial and circular ties at each tier of sockets, and diagonally from one tier to the next above and

* In this chain are the following lights; to the North and East, Carysfort Reef, built on piles driven into the reef; Cape Florida, Jupiter Inlet, and others, iron lanterns on stone towers; to the West and South are Sand Key, Rebecca Shoal, and North West Channel in the Dry Tortugas; all on piles screwed into the shoal. On all of them are Fresnel lights. Carysfort is octagonal, 117 feet above the reef, and 112 above the water, 50 feet diameter at the base; the piles are eight inches diameter, and inserted 10 feet. Sand Key is square, (50 feet at the base,) 120 feet high above high water level, 132 feet above the shoal; it rests on 17 piles, 8 inches diameter, which are screwed in twelve feet.

below. These ties are all of wrought iron and of sizes varying from 5 inches to 1½ inches in diameter. The lower piles are sharpened at the ends, and will be driven into the reef at the proper points. Ten feet above their ends, these piles have collars forged upon them, which rest upon the disks to which the lower diagonal braces are attached. The disks are 8 feet in diameter, and lie on flat surfaces prepared for them, thus supporting the whole weight of the structure. The plate show only those parts which are above the reef.

In the lantern will be exhibited a Fresnel light of the first order.

The weight of the whole is about 300 tons.

The site on which this light will be erected, is the Coffin's Patches Reef or Shoal, situated in latitude 24° 41½′ N., longitude 80° 58′ W., at a distance of 58¼ stat. miles, W. 15° N. from Sand Key, and 60¼ stat. miles E. 42° S. from Carysfort Lighthouse. Hence, one of these lights will always be kept in sight by vessels navigating the coast.

A comparison of the English conoidal tower, with the columnar structure we have described, shows that with the same weight, the latter is 10 feet higher, and 2¼ times the diameter at the base, by so much increasing its stability. In withstanding the shocks of waves or the force of gales, a glance at the plate will demonstrate the superiority of a structure entirely open and composed of separated parts, to one presenting a solid surface which would receive their entire strength; while it might be supposed that an excessive settling of any part, would have a more prejudicial effect upon the whole, in the cast iron tower where the attachment of the plates must necessarily be rigid, than in the other, where every bar would yield slightly before breaking.

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## *The Canal through the Isthmus of Suez.*

(With a Plate.)

The Mediterranean Sea as the link of connexion of Europe with Africa, Asia, and the Indies, is one of the most important points on the surface of the Earth. By its position between these continents, by the numerous islands which it includes, by the long peninsula which stretches out into it, by the number and excellence of its harbors, by the immense riches which it distributes, it commands a collection of political and commercial elements which are not to be found on any other point of our earth. Even small and in themselves insignificant States, obtain from their position on the Mediterranean Sea, an importance which bears no comparison with their power. Were we to place Greece with its present size, on the Danube, or in Middle Europe, it would henceforth occupy as insignificant a position in politics, as Seria, Wallachia, or other continental States of similar size, in place of the inordinate interest which it now commands. And is not the real meaning of the Oriental question, of the existing bloody war, in great part, the struggle for the control of the Mediterranean Sea? On the Mediterranean Sea fought Greeks and Persians, Romans and Carthaginians, Augustus and Anthony for the Empire of the World; and Greece might, perhaps, ever have resisted her con-

querors had she better treasured up the Delphic Oracle, to guard herself with wooden walls (ships).

By the discovery of the Ocean route around the Cape of Good Hope, by the discovery of America, and the conquest of Constantinople by the Turks, as well as by the piracies of the north-western African States, this significance of the Mediterranean Sea was for centuries disturbed, and only the Italian Republics, Venice, Greece, and Pisa, took advantage of it, for the naval power of the Turks was broken at the fight of Lepanto, and Spain prostrated by the Inquisition and civil wars.

How strongly the importance of the Mediterranean has been felt in modern times is shown by the seizure of Gibraltar, the Island of Malta, and the Ionian Island, by the greatest naval nation.

And yet the Mediterranean Sea is at present only a *cul de sac* for ships. A narrow strip of land, scarcely seventy miles broad, obliges the sailor to make a circuit of thousands of miles, and subjects him to a multitude of perils, among which the poisonous fevers and destructive epidemics of the tropics are not the worst. The cutting through the Isthmus of Suez would, therefore, create a new era in politics as well as in trade. By the connexion of the Mediterranean with the Red Sea, the voyage from Marseilles or Trieste to the East Indies will be shortened more than 3000 miles, (French,) between London, Amsterdam, or the Hanse-Towns, and China more than 2000; and even between New York and the south of Asia more than 1000 miles. The reduction of time and capital, which is the necessary consequence of the increased rapidity of transit, will reduce the prices of the absolute necessaries, coffee, sugar, and tea, as well as of cotton and silk, by a third; while, in a short time, the wants of civilization, and with them the products of our industry will spread into these lands, whose increase is even now more rapid than their resources. And yet the financial and commercial results of this undertaking, great as they may be, are but trifles when compared with the incalculable results which the opening of the projected canal must have on the civilization of the whole East.

It is true, that it may seem that by the railroad already commenced between Alexandria and Suez, the closer connexion of the two continents is accomplished. But, although the railroad will insure the desired advantages so far as the travel of passengers and correspondence is concerned, yet the most important part of the trade, the goods, must be excluded from it, in consequence of the four handlings in loading and unloading which they will require, from which so much loss and injury must result as will make the route by the Cape still the preferable one.

The importance of this canal, although never so great as at present, was known from the earliest times. The great King Sesostris or Rhamses II., (1380, B. C.,) was, perhaps, the first who conceived the plan of connecting the two seas. He appears to have designed a canal from the Red Sea to Memphis; and the story is not without probability, that in his time a lively trade existed between Egypt and India. One thousand years later, King Nechos or Nechao resumed the old plan, but without finishing it. The first works, according to Herodotus, cost the lives of 120,000 men, and were interrupted by an oracle, which warned them of the damage which the Egyptians would suffer should

they thus open the way for strangers into their land. A new attempt was made under the Persian rule, by Darius Hystaspes, but Ptolemy Philadelphus first finished the canal, (280 B. C.,) which was named after him. According to Strabo, this canal was 100 feet broad, 30 feet deep, and 50 miles long. It was provided with locks, which were opened for the passage of ships, and then again closed. The largest sailing ships could use the canal, and made their passage through in from 2 to 4 days. The Ptolemean Canal extended from the Pelusian arm of the Nile, below Bubastis, to Arsinóé, a city on the north-eastern part of the Red Sea. About half-way it cut through the Bitter Lake, as the Rhone does through the Lake of Geneva. It brought with it, at the same time, the advantage of watering a large part of the heretofore desert lands of Suez, so that, in a very short time, a crowd of cities and villages sprang up along its borders.

In the times of the Romans, Trajan repaired this canal, and constructed a new arm, which opened into the Nile near Memphis. This addition was known by the name *Amnis Trajanus* (Trajan's River).

Still these canals appear either to have been never finished, or to have filled up with mud, so that from time to time they had to be re-dug.

The Arabs, also, participated in these undertakings. The historian, El Mazin, relates, that, when under the caliphate of Omar, the cities of Mecca and Medina were visited with a severe famine, the Caliph ordered Amru, the Governor of Egypt, to construct a canal between the Nile and Calzum, (Klysma,) so as to enable the grain to be transported from Egypt to Arabia. Amru fulfilled the command, and called the canal the River of the Commander of the Faithful. One hundred and thirty years later, the Caliph Abu Djaffar Almansor caused it to be closed for the purpose of preventing the advance of Ali, who had revolted at Medina, upon Egypt. This canal exists still at the present day. It cuts through Old Cairo and loses itself a few miles farther north-eastward in the *Birket el Hadschi* (the Lake of the Pilgrims). It is still yearly opened with great solemnity at the rise of the Nile. But even were it in order, it could be used only by Nile boats, not by sea ships, and by the first only at the season of the year when the river is at its highest. After this, Egypt and its importance as a passage into Asia, were for a long time laid out of mind, and, although individual enlightened statesmen, such as Colbert, clearly perceived its importance, yet the French Republic was the first to resume the old plan. General Bonaparte openly declared that the time was not far distant when it would be seen that to shake England's power to its foundation, it was only necessary to possess ourselves of Egypt. The Directory issued the following order on the 12th of April, 1798:— "The General-in-Chief of the Army of the East, will cause the Isthmus of Suez to be cut through, and will use every means which may be necessary to secure to the French Republic the free and exclusive possession of the Red Sea. He will expel the English from all their Eastern possessions, and will, in especial, destroy all their settlements on the Red Sea."

It is known why these plans failed. Moreover, the French engineers affirmed that the difference of the levels of the two seas to be joined, exceeded eight metres, an assertion which is now known to be incorrect.

Now has arrived a moment, in which the generally inimical nations, France and England, are friendly, and when Turkey must be more than usually favorable to the projects of the Western powers. The time has accordingly come at which the work is to be begun.

Two plans already marked out under Mehemed Ali, were presented to the present Viceroy Said, by which the projected canal is either to cut the Isthmus in a direct north and south line from Pelusium (4) to Suez (22,) (Plate II.,) or to follow the track from Alexandria to Suez, and so by using the water of the Nile to benefit the whole Delta. The Viceroy, by the advice of those experienced in the matter, has selected the first plan as the shortest and most effective, and, in accord with the consuls of foreign powers, has issued a firman to the engineer-in-chief, Ferdinand von Lesseps, authorizing him to form a company for the canalling of the Isthmus of Suez. This firman contains the following principal points of concession :—

(1.) The company assumes the expense of the undertaking. It will pay the land owners for the ground taken.

(2.) It binds itself to pay into the Egyptian Treasury 15 per cent., and to the original stockholders, 10 per cent. of the net revenue.

(3.) It recognises the supervision of the Egyptian Government over its tariff of tolls and laws.

(4.) It binds itself to guarantee a perfect equality in the tariff to the flags of all nations, and to allow no exclusive privileges to any one.

On these conditions the company receives :—

(1.) The concession of the canal for 99 years from the day of opening.

(2.) The gratuitous grant of all public land which may be necessary for the canal: these constitute the largest part of the necessary territory.

(3.) 75 per cent. of the net receipts for the stockholders.

(4.) The gratuitous grant of all domains of the state, which, at present uncultivated, shall, by irrigation of the company, be made fertile.

(5.) The right to levy a tax upon the lands of such persons as may use the water of the canal for the purpose of irrigating their land.

(6.) The right to take, without pay, from the state quarries, all necessary materials for the canal, and the buildings appertaining to it.

(7.) The entry, free of duty, of all machines and materials which the company may want for the prosecution of its undertaking.

(8.) Remuneration for the materials left at the end of the concession.

(9.) And, finally, the most solemn promise from the Viceroy, that he will assist the undertaking by all means in his power.

According to the preliminary plan made by Ferdinand von Lesseps and Linant Bey in conjunction with two others of the Viceroy's engineers, the whole length of the main canal from the lighthouse at Pelusium, (1,) to the lighthouse of the Red Sea, (29,) will be 120 kilometres, (74·591 statute miles;) its breadth 100 metres, (109·4 yards;) and its depth 8 metres, (26·256 feet;) and the cost is estimated at 100,000,000 francs, ($32,000,000.) But in this sum is included the cost of the feeder, which is to connect the main canal with the Nile, and in time of overflow of the river, to lead its waters to the canal. This feeder (41) passes through the Ouadi Torolat or Tomilat, the land of Goshen of the Ancient Hebrews.

The opening of the feeder into the main canal, Nar et Ouadi (Mouth of the Valley,) (41,) forms the Lake Temsah, (14,) which is made use of as an intermediate haven. In Moses's time, the Red Sea reached this point, and when we see the amount which the Isthmus has gained since that time, the geological opinion prevails, that in pre-historical times, the Red Sea was not wholly separated from the Mediterranean, and that the Isthmus has been formed gradually; an opinion rendered more probable by the shells and other marine remains which the sand and limestone hills of the Isthmus contain.

A main question which was to be resolved by the engineers, and which was subjected to careful examination, concerns the levels of the two Seas, the believed difference of which had heretofore operated as a hindrance to this great undertaking. It appears from the most recent measurements that the level of the two Seas at ebb-tide, is exactly the same; that on the other hand at the flood, the Red Sea rises from 1·8 to 2·5 metres, (5·9 to 8·2 feet,) while the rise of the Mediterranean, at Pelusium, is scarcely perceptible. To overcome this disadvantage, a reservoir (25) will be built at the Red Sea mouth by making a dam across from Suez to the Asiatic Shore. This dam will be provided with sluices, (26), so that the water of the Red Sea, in time of flood, may be let in and retained, and the level of the canal be kept some two metres higher than the level of the Seas at the time of ebb. Although this basin will at first be costly, it is hoped that by dredging machines, it may be kept clear without serious expense.

In the same way the Mediterranean entrance into the canal will be protected by a dam (1) of 6000 metres in length (3·73 stat. miles.) Through the locks in this dam (2) the ships will enter a basin, (3), which will also be used as a mooring place for the boats which accumulate at the mouth.

For the purpose of assuring, for the future, the greatest security to the undertaking, a commission has already been appointed of the most celebrated experts of all nations. To this commission belong, on the part of Prussia, Privy-Counseller, Lentze; on the part of Austria, Baron Negrelli, Director of Constructions in Lombardy; also, Paleocapa, Minister of Public Constructions at Turin; the English Engineer, Rendel; Konrad, for Holland; Renaud, Inspector-General of roads and bridges in France; Lerussaux, the French Marine Engineer. Austria has, moreover, honorably invited Kubli, the Architect from St. Galls, to accompany Baron Negrelli to Egypt.

It is expected that an undertaking which promises such important results for the future, will find favor with the capitalists of all nations.

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The above account of this important undertaking is translated from a German Journal. Have any steps been taken by our Government to have the United States represented in a project which interests us more than any other nation, except England?—Ed.

EXPLANATION OF PLATE II.

A. The main canal, 120 kilometres (74½ miles) long.
1. Mediterranean entrance to the canal, lighthouse, and harbor—dam 6000 metres (3¾ miles) long.

2. Outlet and inlet locks.
3. Reserve basin and mooring place.
4. Tel el Omarein or Faramah. Ruins of Ancient Pelusium.
5. Castle Tineh.
6. Lake Menzaleh.
7. Kantarah del Kasné. Bridge for the road to Palestine.
8. Salieh.
9. Ras Caserum. The Cape Casius, of the Ancients.
10. Katieh.
11. Bir el Bouri (6th station of the engineers 9th of January, 1855.)
12. Ruins of Magdalum (Migdol of the Scriptures.)
13. El Gier. Remains of the ancient canal constructed by Nechos.
14. Lake Temsah. The intermediate harbor.
15. Residence of the engineers.
16. Remains of Serapeum. Buildings probably erected by Darius.
17. Mouth of the ancient canal. Remains of the works.
18. The Bitter Lake; formerly a part of the Red Sea, now dried up.
19. Persian Monument of the time of Cambyses.
20. First station of the reconnoissance.
21. Tel el Klesmeh. The ancient Klysma.
22. Suez.
23. European church.
24. Hotel for the travelers to India.
25. Outlet basin of the Red Sea.
26. Sluices for the purpose of retaining the water of the Red Sea.
27 and 28. Point of crossing for the caravans from Cairo to Mecca or Sinai.
29. Entrance from the Red Sea into the canal. Lighthouse and dam.
30. Reservoir for the water of the Nile.
31. " " rain water.
32. Ancient reservoir for the water from Mt. Attaka.
33. Fortress and wells of Hadscherut.
34. Station for the East India post.
35. Wells of Suez.
36. Road to Cairo.
37. Djebel Attaka (Mt. Attaka.)
38. Mt. Avvebet.
39. Mt. Schebrevvet.
40. Mt. Tieh.
41. The branch canal which connects the main canal with the Nile. Ouadi Tomilat or Torolat (Valley of Torolat); the land of Goshen of the scriptures.
42. Ras el Ouadi, (Mouth of the Valley.)
43. Tel Masruta; traces of the ancient Heroopolis of the Ptolemies, with a statue of Rhamses II.
44. Tel Maofer: Succoth of the Bible. First halt of the Children of Israel; now Om Tihiam (Mothers of Tents.)
45. Tel Naim.
46. Etham of the scriptures. Second halt of the Children of Israel.
47. Roucbet el Buzi. Haroth of the Bible, (Exod. xiv, 2.)
48. Baal Zephon.
49. Bir Marah, (The Bitter Springs, Exod. xv, 23.)

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## *On the Application of Volute-Springs to the Safety-valves of Locomotive and other Boilers.* By Mr. J. Baillie.*

The volute-spring, invented by Mr. Baillie, the locomotive superintendent of the Central Hungarian Railway, was described to consist of "a single plate of steel, wound spirally in a conical shape, and sustaining pressure and deflexion in reference to its breadth instead of thickness.

* From Lond. Journ. of Arts and Sciences, Jan. 1856.

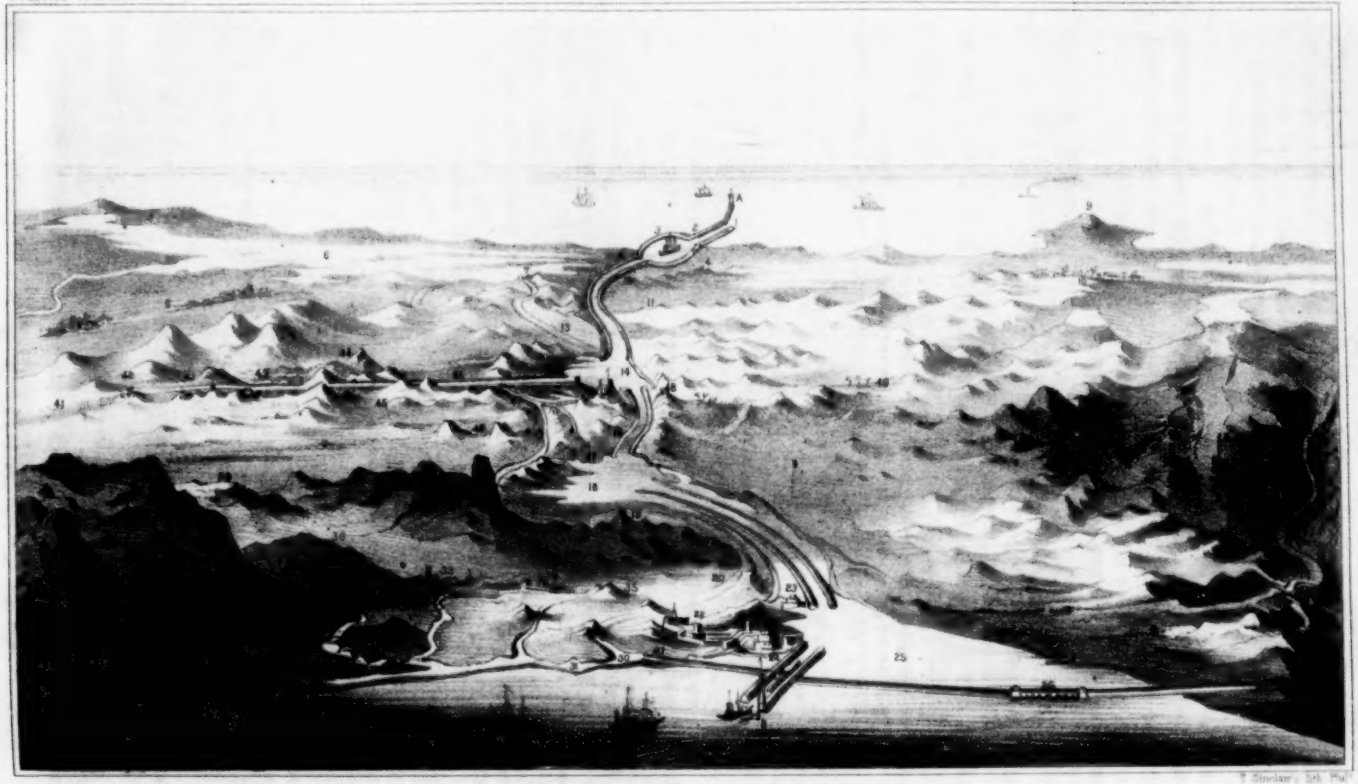
"The effect attained by this form of applying steel to resist pressure was found to be such that equal loads were sustained by one-third the weight necessary for elliptical springs of like capabilities and power.

"From the peculiar mode in which the rigidity and elasticity of the material was applied in these springs, although so very light, they were not liable to break or to be injured by any amount of force, if properly fitted: and the experience of upwards of seven years had proved that they were very economical for all railway purposes. The same experience had proved the unfitness of caoutchouc, or other substitutes for steel, for mechanical application, where great wear and tear had to be sustained; whilst the elliptical form of spring had many disadvantages, which were obviated by the direct action, the compactness, and the elasticity of the volute: and the saving effected by their adoption was not only in the first cost, which was great, but also in repairs, owing to the simple construction and application of the volute; whilst, in addition, much of the iron work necessary in fitting ordinary springs was saved."

It was stated that the volutes had been adapted not only to an immense number of locomotive engines, both abroad and in England, but also to tenders, wagons, trucks, and carriages, for bearing, buffer and traction springs; and in all cases with decided advantage, as to space and durability, over the ordinary elliptical springs. They were also now beginning to be employed as auxiliary springs for common road carts and wagons; and they were proved to be very valuable for many kinds of machines liable to sudden pressure, such as any unyielding substance passing between rollers which would otherwise almost inevitably be fractured.

Concurring in the almost universal opinion of the inadequate dimensions of the safety-valves being the most fruitful cause of explosions, and at the same time appreciating the practical difficulties attendant upon increasing the number of the area of the ordinary valves with the present system of weighting them, Mr. Baillie determined to try whether a safety-valve of large area could not be conveniently and steadily held down by a number of volute-springs of known power: this appeared to act extremely well; and in order to test the new system in comparison with the ordinary method, a safety-valve of 12 inches diameter, held down by seven volute-springs, was adapted to a locomotive boiler, on which there was also an ordinary valve of 3·6 inches diameter, weighted with the usual lever and spring balance. The boiler possessed an area of heating surface of 890 square feet; but, lest the cylinders should take too much steam, the engine remained stationary during the experiments, and the fire was urged by a constant jet of steam, of $\frac{1}{2}$-inch diameter, into the chimney. The two valves were equally weighted to a pressure of 64 lbs. per square inch. The large valve was then fastened down, and in four minutes the pressure of the steam had increased to 105 lbs., when the small valve had risen $\frac{1}{12}$ of an inch, and the experiment was stopped, as the valve could not discharge the steam so fast as it was generated.

The small valve was then screwed down, and the large valve was set free: in four minutes the pressure had only increased from 64 lbs. to 76 lbs. per square inch, or 12 lbs., when the valve rose $\frac{1}{24}$ of an inch; and although the fire was powerfully urged for upwards of half an hour, the pressure of the steam could not be raised beyond 76 lbs., as the large



T. Sinclair's Lith. Phil.

CANAL ACROSS THE ISTHMUS OF SUEZ.

area of the safety-valve allowed all the steam that was generated to escape freely.

These experiments were considered so satisfactory that the system of using volute-springs for the valves had been generally adopted for the boilers of locomotives of the Hungarian and Austrian railways, upon which Mr. Baillie was engaged.

In a recent letter to Mr. Kirtley, it was stated by Mr. Baillie, that eighty-one engines on the Hungarian and Austrian lines were carried upon volute-springs, and it was intended to alter all the others as opportunity offered. Double springs had been generally used for the middle bearing; but it was not now considered necessary, as some engines with single springs appeared to be quite as steady, and not to receive greater shocks than the others. The great point to be attended to was, that the volutes should not be overloaded, nor be screwed down too tightly. A volute of steel $5\frac{1}{4}$ inches broad and $\frac{7}{32}$ inch thick, should not be loaded with more than 20 cwts.—nor one of $4\frac{1}{4}$ inches broad and $\frac{7}{32}$ inch thick with more than 15 cwts.; and it would be still better if their loads were reduced to 18 cwts. and $13\frac{1}{2}$ cwts. respectively.

Great attention should be paid to the due and proportionate loading of the springs under an engine; and the engine driver should be strictly prohibited from altering the position of the nuts on the holding-bolts of the springs; as besides injuring the volutes, an undue weight must be thrown upon the other axles, and damage would ensue to the machine as well as to the rails.

With the ordinary flat springs, it was difficult to ascertain exactly what pressure was put upon them by altering the screws; but with the volutes, a certain law obtained, which rendered evident the absolute pressure to which they were subjected. Each spring was depressed a certain distance by a given weight—say, for instance, those of certain dimensions would be depressed $\frac{1}{4}$ inch by 6 cwt.; so that, if the spring was originally $8\frac{1}{4}$ inches high, when unloaded, it would, under a weight of 18 cwt., have been reduced to $7\frac{1}{2}$ inches in height; then, by trying and marking the trial weights upon the volutes and regulating them accordingly, there could not be any error in computing the pressure upon them.

The weigh-bridge, for ascertaining the exact weight upon each wheel, had been generally adopted with good effect; and to prevent the engineman from altering the weight upon the springs, some thin washers were placed between the cross-bar and the collar upon each holding-bolt, which precluded the possibility of tampering with it. The effect of this regulation had been, that the engine-springs rarely required to be meddled with, and very few fractures occurred, unless the railway was in a bad state.

An illustration was given of the adaptation of the volute-springs to hydraulic safety-valves, for equalizing the pressure on water-mains, and obviating the injurious effects of the concussion caused by the oscillation of the column of water. This system, which had been introduced by Mr. Croker, for the Amsterdam water-works, was easily adjusted to a head of 170 feet, representing a pressure of 39·2 lbs. per square inch, or a total load of 1970 lbs. on the valve; it had been in use for six months, and might be perfectly relied upon.

The arrangement was very simple, consisting merely of a vertical branch of 8 inches diameter, springing from the horizontal main pipe of 6 ins. diameter. On the top of the branch pipe was fixed a valve and seat of gun-metal, so arranged that upon the lugs were fixed the wrought iron bolts holding the cross-bar, between the under side of which and the top of the valve was placed a volute-spring of about 2½ tons pressure; the exact pressure was regulated by adjusting bolts provided with stop-nuts; and the apparatus could be accommodated to the required head with great facility and precision.

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### *Method of Carrying Railway Trains Over Mont Cenis.**

A gentleman of the name of Henfrey has taken out a patent, in Piedmont, for a very ingenious method of carrying railway trains over Mont Cenis, or any other similar mountain pass. The extreme simplicity of the means employed, rivals that of the celebrated discovery of the way to make an egg stand on end. A railway, of the usual description, will be laid down in a direct line from the bottom to the top of the ascent. The acclivity in the case of Mont Cenis will be from one in ten to one in twelve. Between these two rails a canal is to be dug, three feet nine inches in width, and about thirty inches in depth, which is to be lined and made completely water-tight with iron plates of the description called by engineers "boiler-plate." The motive power to be employed is a stream of water, about a foot deep, flowing—or rather rushing—down this canal. It is clear, therefore, that an abundant supply of water on the summit to be reached is a necessary condition of the scheme. Mont Cenis, however, affords every facility in this respect. On the outside of the railway another cogged rail will be laid down on either side. On the arrival of the train at the bottom of the hill, the steam-engine, which has so far brought it on its journey, will be exchanged for a machine of very simple and far from costly construction. In the middle of a frame, about the size of an ordinary steam engine without its tender, a water-wheel, adapted to the above described canal, will be fixed, having a diameter of twelve feet. On the same axis will be fixed two cogged wheels, to work in the cogged rails, of six feet diameter. With this apparatus it seems clear, that the descending stream must force the water-wheel to make revolutions towards the top of the hill, and to carry round with it the cogged wheels in the same direction. As the diameter of these is to be half that of the water-wheel, the rate of ascent will, of course, be half that at which the diameter of the water-wheel moves. It is calculated that the latter speed will be ten miles an hour, and the former therefore five. It is further calculated, that a machine of these dimensions will carry up the proposed acclivity a weight of from fifteen to twenty tons, or say from sixty to eighty passengers. Should it be required to transport a greater weight, as many other such engines may follow each other, at intervals of 150 feet, as may be required. Reckoning the ordinary present rate of traveling up the mountain at two miles and a half an hour, and considering that the direct rail will, between the

* From the Lond. Athenæum, December, 1855.

bottom and the top, traverse a space not more than half the length of the winding post-road, it will be seen that the ascent will be achieved in one-quarter of the time now occupied. For the *descent*, the water-wheel, moving through and against the stream, will act as a restraining force to moderate and regulate the speed. Experiments are now being made in the valley above Susa. In all this we see "no enemy save winter and rough weather." But, judging by our experience of the amenities of the hoary old mountain, we should fear that, unless the plan embraces some provisions against the obstinate foe, King Frost, the field would have tobe abandoned to him for three or four months of the year.

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### *Steam on the Preston and Kendal Canal.**

We are glad to learn that the attempt made by Mr. Rawcliffe (the spirited agent to the Earl of Balcarres, in this town,) to introduce steam on the canal between Preston and Kendal, has answered the expectation formed of it. A screw boat is now at work; the engine, about 20-horse power, having two 8-inch cylinders, and occupying but little space on board, is placed in one boat, and four others are attached behind, forming what might be called a boat train. The quantity of coal conveyed each trip is about 200 tons, loaded in the five boats, and a speed of two miles per hour is maintained. This speed might be increased, we believe, did the depth of water in the canal permit it; but at present, if a greater speed is attempted, a swell of water is created in front of the boat, reducing the level of the canal at the bows so much as to cause the boat to scrape the bottom. By the old system, one horse dragged a boat of from 40 to 45 tons burden, at a rate of one mile and a quarter per hour. During the last fortnight, an extra new iron boat, capable of carrying 57 tons, has been attached to those previously towed by steam (making the five now used), and with this very large additional weight it has only made a difference in speed of three-quarters of an hour per day, and the addition of this extra weight has consequently retarded the boats almost imperceptibly. A new iron boat has just been built for the same purpose, to be worked by steam power. She is a twin paddle-boat. Two boats, each 60 feet long, having one central paddle working between them, and this arrangement prevents the usual swell which the ordinary river paddle-boats create. This steamer has already been tried on the canal, and is found to require less power to do the same work than the screw boat alluded to above. These experiments, combined with the substitution of iron for wood in the construction of the boats, open quite a new feature in the history of canal navigation.—*Preston Pilot.*

* From the Lond. Mechan. Mag., December, 1855.

# AMERICAN PATENTS.

*List of American Patents which issued from January 22d, to February 12th, 1836, (inclusive,) with Exemplifications.*

## JANUARY 22.

123. For a *Machine for Bending Plough Handles, &c.;* Benjamin F. Avery, Louisville, Kentucky.

*Claim.*—"The strap. Also, the combination and arrangement of the several devices constituting the machine."

124. For a *Method of Opening and Closing Farm Gates;* J. A. Ayres, Hartford, Conn.

*Claim.*—"1st, The employment and arrangement of the double-acting self-adjusting jointed treadle, in combination with the self-locking catches. 2d, Opening and closing the two parts of the gate and re-adjusting the driving boards by means of the simple arrangement of mechanism, consisting of weighted crank-shaft, elbow links, and connecting rods, arranged and combined with the two parts of the gate and the driving boards."

125. For an *Improvement in Flouring Mills;* Thomas Crane, Fort Atkinson, Wis.

*Claim.*—"Securing the bed stone within a hoop rising from a suitable bed plate, when the said hoop has an open annular space surrounding it, which is supplied with a discharging spout, and has a rotating hoop arranged and operating therein."

126. For an *Improvement in Eccentric Explosive Shells;* Wm. W. Hubbell, Philadelphia, Pennsylvania.

*Claim.*—"The combination of the head or segment of the solid sphere, with flat base uniformly around the fuzee hole, with the segment of the hollow part forming a spherica-shell with flat based heads."

127. For an *Improvement in Cotton Seed Planters;* John M. Jones, Assignor to Newton Foster, Palmyra, New York.

*Claim.*—"The disk constructed with exit apertures, cavities, and ratchet; and, also, the vibrating rim with flexible arms thereon; the said disk being rotated upon said rim, in combination with, and in opposite direction to, the flexible arm."

128. For an *Improvement in the Arrangement of Tan Vats;* David H. Kennedy, Reading, Pennsylvania.

*Claim.*—"The arrangement of a tank, the tan vats, the main supply pipes, and their branches, whereby the tanning liquor may be caused to flow regularly through a series of vats from one to another without the aid of pumps, and any one or more of the vats may be insulated from the system of circulation for any required length of time without impeding a regular circulation of the tanning liquor through the rest."

129. For a *Machine for Dresssing Sticks to Polygonal Forms;* Joseph W. Killam, East Wilton, New Hampshire.

*Claim.*—"Planing at one operation sticks of timber of polygonal form straight and out of wind, without confining the same to a carriage by using the combination and arrangement of the feed rollers and the bed, and the guide plates and weights with the rotary cutter heads."

130. For an *Improved Riveting Machine;* Emmons Manly, Marion, New York.

*Claim.*—"The arrangement of the punch, lever, and mandril, in relation to the anvil and self-adjusting hammer head."

131. For an *Improvement in Mowing Machines;* Joseph S. Manning, Philadelphia, Pennsylvania.

*Claim.*—"Forming the teeth or fingers with a central rib, (closing the usual slot,) in combination with cutter plate and reciprocating blades, for the purpose of more effectually

preventing clogging of the cutter. Also, the device for elevating the cutter bar or beam, consisting of pulley or windlass, ropes, and straps passing over the shoulders of the horse."

132. For a *Method of Ventilating Railroad Cars;* Wm. H. Medcalfe, Baltimore, Md.

*Claim.*—"The passing of a current of air, the force of which is regulated by the motion of the car and a self-regulating bonnet, through a body of water, which water is retained within a certain space by a certain number of wire screens; the air thus freed from water, dust, cinders, &c., is carried directly into the car through registers or by pipes around the stove and out of the car by a similar apparatus (emptied of water) after the air has been used."

133. For an *Improvement in Machines for Hammering Leather for the Soles and Heels of Boots and Shoes;* Jean Pierre Molliere, Lyons, France; patented in France, July 22, 1853.

*Claim.*—"The hammering of sole leather upon a hard surface after it is cut into heel and sole strips, for the purpose of closing its pores without any displacement thereof, in order to render it water-proof by means of steel hammer heads of slightly rounded face attached to the hollow rods, which may be weighted at pleasure, and shall be so governed by a cam movement, that no two strike at the same moment, while they are kept by their shoulder piece from crushing the leather after it is hammered."

134. For an *Improvement in Sewing Machines;* John O'Neil, Xenia, Ohio.

*Claim.*—"The broad chisel-edged piece, which takes hold of several of the warp or weft threads, and thus feed along the material without piercing or penetrating the cloth, when such edge is of sufficient width to catch or hold the several threads of the fabric being sewed."

135. For an *Improvement in Grate Bars;* John T. Osborn, New Orleans, Louisiana.

*Claim.*—"Increasing the height of ordinary grate bars of furnaces, by an addition to their top of a piece having its sides concave and without any fags in its entire length."

136. For an *Improved Method of Regulating Velocity of Wind Wheels;* Francis Peabody, Salem, Massachusetts.

*Claim.*—"1st, The wind gate. 2d, The method of controlling the wheel by means of the rods and screw."

137. For an *Improvement in Seed Planters;* Freeman Plummer, Manchester, Ind.

*Claim.*—"The seed cap as formed by the slide, conductor, and hinge."

138. For an *Improvement in Means for Operating the Steam Valves in Blower Engines;* James P. Ross, Lewisburgh, Pennsylvania.

*Claim.*—"The cam yoke, in combination with the adjustable weights and counterpoise levers, or the mechanical equivalents of these several parts."

139. For an *Improved Method of Boxing Carriage Wheels;* Charles Schmitt, Union, Missouri.

*Claim.*—"A new and useful machine for boxing carriage wheels."

140. For *Improved Primers for Cartridges of Fire Arms;* Horace Smith, Norwich, and Daniel P. Wesson, New Haven, Assignors to "The Volcanic Repeating Arms Company," New Haven, Connecticut.

*Claim.*—"The combination of a copper or brass case, an iron or steel disk, with cork, or its equivalent, and fulminating powder."

141. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois.

*Claim.*—"In connexion with a dividing piece for throwing the grain inwards from the extreme ends of the cutters or platform, a recess or space, behind said space, into which a portion of the grain may afterwards drop and be cut, for the purpose of obviating the tendency to choke or clog at the ends of the cutters. Also, the intermediate piece between the tongue and the cutter beam, for the purpose of providing a yielding or elastic joint, not only at or about the line of the cutters, but also at the heel of the tongue. Also, in combination with the lever, having its fulcra pivoted intermediately

between the tongue and the frame of the machine, the strap and hinged supporting piece, for the purpose of regulating the height of the cutters."

142. For an *Improvement in Harvester Cutter Bars;* John H. Manny, Rockford, Ill.

*Claim.*—"The tempered steel finger bar, by which the delivery of the cut grain or grass upon the stubble is facilitated, and other advantages."

JANUARY 29.

143. For an *Improvement in Means for Operating the Throttle Valve of Steam Engines;* Abel Bisbee, Chelsea, Massachusetts.

*Claim.*—"Raising and lowering the vibrating toe, by means of the lever, operated by the governor."

144. For an *Improvement in Shot Pouches;* Joseph T. Capewell, Woodbury, Conn.

*Claim.*—"My improvement in the construction of a cut-off, having the lower edge or bottom straight; also, having the vertical edges turned up (or over). Also, the mode of fastening the rings around the main tube or throat of the shot pouch."

145. For an *Improvement in Field Fences;* Thomas J. Carleton and Stephen Post, York, Ohio.

*Claim.*—"A fence constructed of rails, secured to each other, and supported at proper distances above the ground, by posts composed of iron rods, twisted alternately round each other and around the rails; and one, or both of the rods, bent down from the top of the fence, to brace it to the case in which the rods are fixed."

146. For an *Improvement in Locomotive Furnace Grates;* George R. Comstock, Manheim, New York.

*Claim.*—"The simultaneous raising of the grate and opening of pipes at will, for aiding the combustion of fuel in the furnace, during the running of the engine, by the combination of the reciprocating plates or stop rod, and parts connected therewith."

147. For an *Improvement in Machines for Replacing Railroad Cars;* Henry A. Degraw, Piermont, New York.

*Claim.*—"The combination of the self-adjusting packing wedge, attached to an elastic or yielding rod, with the bars, operating levers, and griping jaws, constructed and arranged for operation together, in such a manner, that while upon the depression of the hand lever, which effects the movement of the car, or locomotive wheel, the griping jaws are made to firmly grasp the rail to secure a steady fulcrum, for the operation of the lever, the packing wedge follows up the movement of the wheel to retain it in the place to which it has been moved, and upon raising the hand lever, the griping jaws are released, and the whole implement may be run forward on the rail, for a further joint action of the self-adjusting wedge and gripe of the jaws as a prop, to follow up the work repeatedly and progressively."

148. For an *Improvement in Brick Machines;* Louis T. Delassize, New Orleans, La.

*Claim.*—"The combination of the sectional pinion and spring-toothed crane, with the rock shaft and pressing rods."

149. For an *Improvement in Scaffolds;* Charles Foster, Philadelphia.

*Claim.*—"A scaffold, consisting of the combination of the adjustable uprights, the movable brackets for supporting the foot boards, and the horizontal adjustable ties; and also held or secured in a perfectly steady position near the building which is to be repaired, or painted, without direct contact with the wall of the same, by means of the jacks and the braces."

150. For an *Improvement in Telegraphic Registers;* Moses G. Farmer, Salem, Mass.

*Claim.*—"That modified combination of parts, by which the self-acting telegraphic repeater, the breaking, instead of the closing of the local circuit is made to close the main circuit, and by which, throughout, the breaking of the local circuit is made a substitute for closing."

151. For an *Improvement in Apparatus for Heating Buildings by Steam;* Stephen J. Gold, New Haven, Connecticut.

*Claim.*—"The automatic governing of the draft and the shutting off of the same, by

the forcing of water from the boiler, by pressure of steam—or in other words, establishing the hydraulic seal. Also, the automatic government of the valve, by the forcing of water from the boiler, by pressure of steam. The governing of draft valves by expansion of water being expressly disclaimed."

152. For an *Improvement in Universal Joint for Connecting Shafts, &c.;* John Hinkley, Huron, Ohio.

*Claim.*—"Connecting shafts when placed angularly with each other, by means of the universal joints, by which a rotary motion may be communicated from one shaft to the other."

153. For a *Mortising Tool;* Hazard Knowles, City of New York.

*Claim.*—"Combining in one instrument, a series of chisels, of the width required to give the desired form to the wood to be cut, when the said chisels are arranged in succession, on a line oblique to the line of motion of the entire series, and with gullets interposed, to receive and hold the wood cut by each chisel, until it passes through the thickness of the material to be cut—by which combination and arrangement, the desired form is given at one operation, by the breadth of the chisels, and by the inclination of the series to the line of motion of the cutting edge. Also, the employment of an instrument composed of the combined series of chisels, in combination with the jaws on which the wood to be mortised is placed, which jaws are to be adjustable, relatively to the line of motion of the said instrument, and the inclination of the series of chisels, as to sustain the under surface of the wood, outside of the form intended to be cut, and to act as resisting shears, in conjunction with the chisels, which finish the cutting of the desired form."

154. For an *Improvement in Pill Making Machines;* Noah W. Kumler, Cincinnati Ohio.

*Claim.*—"The combination of the adjustable plates, apron, pulley, and drum—and these, in combination with the grooved roller and segmental plate."

155. For an *Improved Apparatus for Stenciling Window Shades;* Daniel Lloyd, City of New York.

*Claim.*—"1st, Producing patterns on window shades, in which long or continuous lines form a prominent feature, by means of pairs of stencils of the full size of the design. 2d, The mode of registering the stencils, by use of the movable piece, in combination with the fixed stops, for the purpose of readily adapting the stencils to shades of various widths."

156. For an *Improvement in Mastich for Covering Walls;* Adolph C. Moestue, Kane County, Illinois.

*Claim.*—"The glazing of surfaces, previously coated with rosin or its equivalent, by a naked flame."

157. For an *Improvement in Grinding Mills;* Lucius Paige, Cavendish, Vermont.

*Claim.*—"Arranging and combining with a screw, one or more wheels and a hopper, whereby such mechanism is made to answer the purpose of a mill for grinding."

158. For an *Improvement in Machines for Cutting Flocks and Paper Stock;* Joseph N. Pitts, Blackstone, Mass.

*Claim.*—"The combination of the cylinders provided with spiral knives, cutters, attached to the adjustable and elastic or yielding bars, and the drum."

159. For an *Improved Punching Machine;* Rufus Porter, Washington, D. C.

*Claim.*—"The use of the double quadrant, in combination with the tappet, the sliding shaft, when the several parts are arranged and operated, in connexion with the fly-wheel."

160. For an *Improved Hinge;* George M. Ramsay, City of New York.

*Claim.*—"The anti-friction roller, in combination with a joint hinge."

161. For an *Improvement in Bee-Hives;* H. G. Robertson, Greenville, Tenn.

*Claim.*—"Making the joints hollow, and stuffing them with caustic lime, or other matter offensive to insects."

162. For an *Improvement in Machines for Clearing Snow from Railroad Tracks;* Riley Root and Samuel G. Holyoke, Galesburg, Illinois.

*Claim.*—"The arrangement of a rotary fan blower, provided with knives, and made sufficiently large to sweep the entire width of the track."

163. For an *Improvement in Screw Jacks;* Henry F. Shaw, Boston, Mass.

*Claim.*—"The 'screw-jack,' consisting essentially of the screw, plates, and double pawls."

164. For *Improved Chimney Cowls;* Charles F. Thomas, Taunton, Mass.

*Claim.*—"Arranging the vane, so that it shall extend directly across the discharging aperture of the cowl, or ventilator, and divide such aperture. Also, constructing the vane of two wings, flaring from one another, as they extend from the cowl. Also, arranging each of the wings, so that it shall extend down below the discharging aperture of the cowl and from and around the external surface of the cowl."

165. For an *Improved Method of Attaching Teeth to Saw Plates;* Philos B. Tyler, Springfield, Mass.

*Claim.*—"1st, The hardened nib holders, attached to the saw plate, at each tooth, to hold a small cutting nib. 2d, The cutting nibs attached to the saw teeth, whether by means of the nib holder, or directly connected with the plate."

166. For an *Improved Device in Tree-nail Machines;* Elbridge Webber, Gardiner, Maine.

*Claim.*—"The construction of the traversing forming box of a flaring mouthed bit holder, combined with the slide, whose upper surface composes so much of the form box opening as lies below the plane of the bit seat, produced perpendicular, to which plane said slide is adjustable, for changing the size of the tree-nail."

167. For an *Improvement in Buggy Wagons;* Thomas Winans, Baltimore, Md.

*Claim.*—"The combination of bent bars and springs, to connect the fore and hind axles, support the seat, with both the requisite firmness and elasticity, and to permit the front wheels to pass under the seat, in turning short round."

168. For an *Improvement in Belt and Band Fastenings;* George D. Young, Plymouth, Massachusetts.

*Claim.*—"A clasp, for uniting the ends of a belt or band—consisting of the bottom plate, with its vertical studs, and the turning bottom, or its equivalent."

169. For an *Improved Soldering Iron;* Daniel Dod, Assignor to self, and Henry F. Read, Brooklyn, New York.

*Claim.*—"The combination of a hollow bit of copper, with movable centres of iron."

170. For an *Improvement in Machines for Cutting Mouldings on Marble;* Hiram L. Houghton, Assignor to Abel H. Grennel, Springfield, Vermont.

*Claim.*—"The method of cutting mouldings upon the edges of blocks, by the employment of the disk and the adjustable table top."

171. For an *Improved Cell Lock;* Edward Kershaw, Assignor to self, and Henry M. Hooper & Co., Boston, Massachusetts.

*Claim.*—"The combination of the bars, having notches at certain proportioned distances, operating in connexion with the studs on the cell door."

172. For an *Improvement in Flouring Mills;* Joseph Weis, Bordentown, N. J.

*Claim.*—"The longitudinal grooves between the dove-tailed steel pieces."

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### Re-Issues for January, 1856.

1. For an *Improvement in Ploughs;* Samuel Hulbert, Ogdensburgh, New York; patented September 20, 1853; ante-dated September 20, 1852; re-issued January 1, 1856.

*Claim.*—"Constructing a mould board and moulding part of the share of a plough, so that a horizontal line drawn at any height across their working side, shall describe a

convex arc of a circle, and any line drawn across its working side, at right angles to the base, shall also describe the convex arc of a circle, separately or connectedly."

2. For an *Improvement in Cotton Presses;* Nathan Chapman, Mystic River, Connecticut; patented August 8, 1854; re-issued January 8, 1856.

*Claim.*—"The recesses or slots in the hubs of the toothed wheels on which the chains that raise the follower work, for receiving the lower ends of the chains when wound up, and bringing the pressure nearer the centre of the bearings of the wheels."

3. For a *Machine for Composing and Setting Types;* William S. Loughborough, Rochester, New York; patented October 23, 1855; re-issued January 8, 1856.

*Claim.*—"1st, The composing wheel. 2d, The means above described for delivering the types from the various cells to the jaws of transits, or their equivalents, fixed to a wheel or other rotary apparatus. 3d, The construction and application of the transits, as described, or their equivalents, attached to a wheel or other rotary motion, to convey the types from the slides, or their equivalents, to the gally or composing chamber. 4th, The devices for effecting the delivery of the types from the cell of small js, and those cells which are similarly conditioned in case of italics. 5th, The construction and arrangement of the lever and its head. 6th, The construction and arrangement of the justifying bar, in combination with the cam ratch. 7th, The index, fixed to the bar, by which it is operated, in combination with the index plate. 8th, The application of the detent, operating as described. 9th, The construction and arrangement of the lever, in combination with the "rule" or line register. 10th, The tappet, constructed as described, so as to effect the horizontal and vertical changes of the lever. 11th, The detents, so applied as to retain the slides, when they are thrown back after delivering a type."

4. For an *Improvement in Machines for Washing Paper Stock;* Horace W. Peaslee, Melden Bridge, New York; patented January 23d, 1855; ante-dated September 20, 1854; re-issued January 8, 1856.

*Claim.*—"The employment of a wire gauze or reticulated cylinder with open ends, and placed with its axis in a horizontal or nearly horizontal position, and with its lower part revolving in a trough of water; but this I only claim when the said cylinder is provided on the inside with hooked or bent teeth, for the purpose of catching and elevating the paper stock in separate portions, to drain the water out of it, and drop it in the water, and thus subject it to the several operations required, as it is moved from end to end of the cylinder. Also, in combination with a reticulated cylinder armed with hooked teeth, and rotated in a trough of water, the employment of inclined curbs, at the delivery end of the cylinder, for the purpose of regulating the delivery of the paper stock."

5. For an *Improvement in Track Clearers for Grass Harvesters;* Abner Whitely, Springfield, Ohio; patented August 22, 1854; re-issued January 8, 1856.

*Claim.*—"The rolling cone, moving on the axis, at an acute angle to the finger piece, and furnished with a joint clearer, as described, and for the purpose of clearing a track, in the cut grass."

6. For an *Improvement in Machines for Threshing and Winnowing Grain;* Andrew Ralston, Middletown, Pennsylvania; patented February 21st, 1842; re-issued January 15, 1856.

*Claim.*—"1st, The peculiar construction in chaff screen, which consists of a thin plate of metal, punched with a semi-circular instrument for the purpose of producing semi-circular apertures, and at the same time leave the parts of the metal thus partly punched from said plate, overhanging said apertures, at an angle greater than that of the plate, for the purpose of allowing the grain to pass through said apertures, and at the same time prevent the chaff and straw entering them, and thereby preventing choking. 2d, the combination of the system of screens, the blower, and the elevators, for cleaning and conveying the cleaned grain to the granary, or other place of deposit."

7. For an *Improvement in Sewing Machines;* Thomas J. W. Robertson, Assignor to self, and Alfred E. Beach, City of New York; patented March 20, 1855; re-issued January 15, 1856.

*Claim.*—"1st, The combination of the spring clamp, with the feeding bar or dog, constructed, arranged, and operating together against the cloth on its one side or surface. 2d, The arrangement for effecting the feed, that is to say, setting the arm of the feed

finger at such angle to the table that the diagonal direction of the thrust will cause the reciprocating motion imparted to the upper end to produce, in combination with the table, a lateral motion thereon of the feed finger, as well as the requisite pressure for griping and feeding the cloth."

8. For an *Improvement in Apparatus for Dissolving Silica;* Benjamin Hardinge, City of New York; patented May 8, 1855; re-issued January 22, 1856.

*Claim.*—"The method of taking the liquid from the upper part of the charge in the boiler or digester, containing the silicious matter and the solvents thereof, passing it through a heater, and discharging the vapor thereof in the lower part of the charge, when this is combined with a boiler or digester provided with stirrers for stirring the charge."

9. For *Improvements in Sewing Machines;* Allen B. Wilson, Pittsfield, Mass.; patented November 12, 1850; re-issued January 22, 1856.

*Claim.*—"Forming a stitch by each throw of the shuttle, and corresponding motion of the needle; that is to say, making one stitch at each forward, and another at each backward motion of the shuttle, this being effected by the needle in combination with the shuttle."

10. For *Improvements in Sewing Machines;* Allen B. Wilson, Pittsfield, Mass; patented November 12, 1850; re-issued January 22, 1856.

*Claim.*—"The method of causing the cloth or the material to be sewed in a sewing machine, to progress regularly, by the joint action of the surfaces between which it is clamped, and which act in conjunction. 2d, Holding the cloth or other material at rest, by the needle, or its equivalent, in combination with the method of causing it to progress regularly, 3d, Arranging feeding surfaces, in such relation to the needle, that they, or one of them, shall perform the office of stripping the cloth or material from the needle, as it rises or recedes from it. 4th, So mounting and attaching one of the feeding surfaces to some other part of the machine, as that it may be removed or drawn away from the other surface at pleasure."

11. For an *Improvement in Grinding Mills;* Amory Felton, Troy, N. Y.; patented January 2d, 1855; re-issued January 29, 1856.

*Claim.*—"1st, In combination with the cylinder and concave, the cap, provided with spiral ribs on its under side, for carrying forward the ground material towards the discharge end, and thus to make room for that which follows, and prevent clogging and choking. 2d, In combination with the cylinder, concave, and cap, the fingers, for agitating the material, and causing it to pass more readily in between the cylinder and concave."

12. For an *Improvement in Harvesting Machines;* John Reily, Hart Prairie, Wisconsin; patented November 20, 1855; re-issued January 29, 1856.

*Claim.*—"1st, The retracting divider. 2d, The grain guard."

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DESIGNS.

1. For *Hall Pendants;* Samuel B. H. Vance, Assignor to Mitchell, Bailey & Co., City of New York; patented January 1, 1856.

*Claim.*—"The configuration and arrangement of the several parts and ornaments combined as set forth."

2. For *Hall Pendants or Chandeliers;* Samuel B. H. Vance, Assignor to Mitchell, Bailey & Co.; patented January 1, 1856.

*Claim.*—"The design, configuration, and arrangement of the several parts and ornaments."

3. For *Perfumery Bottles;* Augustus E. Wetherill, Cincinnati, Ohio; patented January 8, 1856.

*Claim.*—"The ornamental design of bottle."

4. For *Cooking Stoves;* Garettson Smith, Henry Brown, and Joseph A. Read, Assignors to James G. Abbott and Archilus Lawrence, Philadelphia, Pennsylvania; patented January 22, 1856; ante-dated December 31, 1855.

*Claim.*—"The design, configuration, and arrangement of the several ornaments in bas-relief, and mouldings, on the plate of stove 'Premium.'"

5. For *Portable Furnaces;* Garettson Smith, Henry Brown, and Joseph A. Read, Assignors to A. E. Warfield, Philadelphia, Pennsylvania; patented January 22, 1856; ante-dated December 31, 1855.

*Claim.*—"The design, configuration, and arrangement of the several plates and ornaments thereon, constituting a new design for portable furnaces."

6. For *Portable Ranges;* Garettson Smith, Henry Brown, and Joseph A. Read, Assignors to A. E. Warfield, Philadelphia, Penn.; patented January 22, 1856; ante-dated December 31, 1855.

*Claim.*—"The design, configuration, and arrangement of the ornaments in bas-relief, and mouldings on the several plates."

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## FEBRUARY 5.

1. For an *Improvement in Bell Stench Trap;* Charles H. Bush, Fall River, Mass.

*Claim.*—"Providing the said grating or perforated plate of the sink with a funnel neck or tube, arranged centrally over and in combination with the bell or cup, made separate or detached from the grating for operation together, as described, for greater convenience in the use, and better cleansing of the trap, with total exemption from escape of effluvia in the apartment wherein the sink is placed, under every use of the trap by the funnel, or otherwise."

2. For an *Improvement in Corn Dryers;* Solomon Bernheisel, Tyrone Township, Pennsylvania.

*Claim.*—"The perforated pipes, in combination with the hopper, placed above the hot air chamber, so as to allow the air to pass between the inner perforated pipe, and the smoke pipe, while the hot air from the chamber passes up between the outer perforated pipe, and the exterior pipe or casing."

3. For an *Improved Ore Washer;* William Ball, Chicopee, Massachusetts.

*Claim.*—"The trough, when constructed with the ledge, and operated in connexion with a head of water, kept above the level of said ledge."

4. For an *Improved Raking Attachment to Harvesters;* A. H. Caryl, Sandusky, Ohio.

*Claim.*—"Operating the rake, that is, the rod provided with teeth, by means of the weight and pulley, the weight and pully being connected to the rod by chains, and otherwise arranged as described."

5. For an *Improved Photographic Plate Vise;* Levi Chapman, City of New York.

*Claim.*—"The arrangement of the jaw, with the piece between the slides, and between the cross piece, acted on by the crank piece, or its equivalent, when combined with the jaw, changeable in the grooves, in the sides of the trough."

6. For an *Improvement in Lugs for Cast Iron Shingles;* John Cook, Westmoreland, New York.

*Claim.*—"The projection, with the nail hole on the under side of the shingle, for fastening the same to the rib, either on its upper or lower edge at choice, and for securing the nail from the wet, thereby preventing it from rusting and becoming loose."

7. For an *Improvement in Pumps;* Edward N. Dickerson and Elisha K. Root, Hartford, Connecticut.

*Claim.*—"Two buckets working in pump barrels, so arranged that the column to be raised, passes through both in succession, in combination with the spiral cams, or their equivalents, so arranged as to move said buckets, with uniform velocity, and to maintain practically, a uniform and constant lifting action upon the water. 2d, Imparting to the column of water by means of a reciprocating pump, a constant and uniform flow, through the ascending main."

8. For an *Improvement in Heating Feed-water Apparatus for Locomotives;* Peter S. Ebbert, Chicago, Illinois.

*Claim.*—"The auxiliary pipe, so arranged in relation to that part of the main pipe, containing a valve, that a communication may exist between the water space of the boiler, and the interior of the feed-water pipes in the smoke stack, when the feed pump is not in operation."

9. For an *Improved Saw Set;* Joseph G. Ernst, York, Pennsylvania.

*Claim.*—"The use of the expanding arms, in connexion with the plate and screw nut, arranged and operated in the manner described."

10. For an *Improvement in Cutting Files;* Major H. Fisher, Sing Sing, New York, Assignor to Joseph A. Hyde, Bridgewater, Massachusetts.

*Claim*—"The sliding and self-adjusting chisel holder, constructed and operating substantially as described."

11. For an *Improvement in Three Wheeled Vehicles;* Elisha S. French, Binghampton, New York.

*Claim.*—"The combination and arrangement at the rear of the vehicle, of the castor-hung swiveling wheel, in such connexion with the perch or body, that while in the forward run of the vehicle, the said wheel runs in a parallel course, central to the other two (advance) wheels, and at a considerable distance behind them, it, in backing the vehicle, is caused to occupy a like parallel and central position with its rim or tire, in direction of the travel, but in closer proximity to the fore wheels, and on the reverse side of the swivel, towards the front end of the vehicle, and out of the way as it were, whereby additional facilities are afforded for backing the vehicle in a crowded thoroughfare, and the other advantages specified are obtained."

12. For an *Improved Feed-water Apparatus to Steam Boilers;* Thomas Firth, Cincinnati, Ohio.

*Claim.*—"The arrangement of the pistons, beam, pins, (attached to the valve,) and spring, or their equivalents, for giving motion to the steam valve, for admitting steam to and from the steam cylinders and pipes attached thereto."

13. For an *Improved Bench Vise;* Thomas Gissinger, Alleghany, Penn.

*Claim.*—"The projection (*g*,) and the projections (1) and (8,) arranged as described, and for the purposes set forth."

14. For an *Improvement in Machines for Making Rope;* Elisha Harris, Providence, Rhode Island.

*Claim.*—"The movable self-adjusting trumpet guide, as described."

15. For an *Improvement in Brick Presses;* Henry J. Hughes, Davenport, Iowa.

*Claim.*—"1st, The table actuated as described, or by any other equivalent means by which the bricks are discharged after being pressed, and by which they are borne away from the press-head. 2d, The specific arrangement for oiling the mould during its passage up and down over the head."

16. For an *Improvement in Hot Air Furnaces;* Samuel Macferran, Philadelphia, Pa.

*Claim.*—"1st, Connecting the inner end of the bottom plate of the space for supplying the furnace with fuel, a ring for supporting and holding together the segmental plates of the fire-pot, so as to enable said ring to be held firmly by its connexion with the plate, which is secured to the front part of the furnace. 2d, Arranging the adjustable horizontal plate having spaces in its edges, in which the heating pipes fit above the fire-pot, and capable of being raised and lowered for the double purpose of diverging the heat entirely around the said heating pipes, and in contact with the sheet iron radiating casing, and regulating the draft of the furnace, and in fact, converting into an air-tight heater if desired."

17. For an *Improvement in Carriage Springs;* Richard Montgomery, City of N. Y.

*Claim.*—"The corrugated spring, when used in connexion with the elliptic spring, as described."

18. For an *Improvement in Weighing Scales;* S. S. Mills and M. Bissel, Charleston, South Carolina.

*Claim*—"Connecting the scale beam with arms, two or more, and otherwise arranged

as shown, so that either of the weights on the arms may, when not in use, be placed in line with the fulcrum of the beam."

19. For an *Improvement in Flour Bolts;* Stephen C. Mendenhall, Richmond, Ind.

*Claim.*—"1st, The direct and positive expansion and contraction of the valves, between fixed and varying points. 2d, The combination of the expanding and contracting valves with the cords, pulleys, drums, and indicators, or their equivalents."

20. For an *Improvement in Fire Pokers;* George R. Moore, Mount Joy, Pa.

*Claim.*—"The arrangement, or any of their equivalents, by which the several motions of the poker are obtained; also, the arrangement, or its equivalent, for contracting the handle of the poker at pleasure."

21. For an *Improvement in Lanterns;* Francis Morandi, Boston, Massachusetts.

*Claim.*—"The funnel, applied to the lantern, in the manner set forth."

22. For *Improved Fastenings of Hinges for Daguerreotype Cases;* Samuel Peck, New Haven, Connecticut.

*Claim.*—"The combination of the metal straps or supports, with the material of the case, when the same is plastic, so as to strengthen the case and form a secure fastening for the hinges."

23. For *Improved Metallic Pens;* Myer Phineas, City of New York.

*Claim.*—"The spring, when placed under the upper side of the pen, and so constructed and arranged as to serve the two-fold purpose described."

24. For an *Improvement in Oscillating Engines;* Juan Pattison, Brooklyn, N. Y.

*Claim.*—"The arrangement of parts, viz: the arched steam pipe, saddle hollow valve, and chest, for the passage and distribution of steam on cylinders of oscillating steam engines."

25. For an *Improvement in Harvesters;* B. F. Ray, Baltimore, Maryland.

*Claim.*—"1st, Providing the main or driving wheel of reaping and mowing machines, with a stationary guard plate. 2d, The slide bar arranged in the said horizontal plane, with, and perpendicular to, the axle of the driving wheel of reaping and mowing machines, in combination with the bell crank, for the purpose of giving direct and positive motion to the cutting apparatus, when arranged obliquely to the line of draft. 3d, Forming in the sliding bar a slot for the reception and operation of the bell crank."

26. For an *Improvement in Saw Mills;* John S. Snider, Lancaster, Ohio.

*Claim.*—"Such construction of the scale wheel and its combination with the large cog wheel, that the position of the lever when on its rest, will be always zero, and that the log may be moved at both its ends equally any required distance by raising its lever from its rest, and counting one-eighth of an inch, or a different fraction, according to the cast of the wheels for each cog that the pawl may pass over, and pressing the lever down again upon its rest, when the requisite distance is obtained, so that the setting of the log requires no calculations or reference to a scale, and may be done with perfect accuracy by the ear, or by the eye, and it is thus set at both ends by a single scale wheel, and a single pawl, and thus set necessarily exactly alike at both ends, which is not the case where the ends are set each by its separate framing. Also, the combination of wheels which are so adjusted as to effect the abovenamed objects, and also, to give greater power to the lever in moving heavy logs and more accuracy in adjusting them, as the log is thus made to move slow in proportion to the motion of the lever, and is not subject to be put out of its place by its own momentum, or by the spring of the rods. Also, in this construction and combination, the journal, and the pinion wheel, and scale wheel are cast together, and the rod passes through the journal and moves with it, so that the lever when pressed down moves the pinion wheel, which gives motion to the wheel which moves the head-block slide, and at the same time the journal moves the rod, and by it the tail-block slide, so that the rod communicates motion to the tail-block slide only, and is not put to the strain requisite to move both slides, and with them both ends of a heavy log."

27. For an *Improvement in Sewing Machines;* Alfred Swingle, Assignor to Elmer Townsend, Boston, Mass.

*Claim.*—"As a tension apparatus, the combination of a rotary grooved roller and a pressure roller, operating by means of a spring, or its equivalent, as specified; the same when a wax thread is used, producing advantage substantially as stated."

28. For an *Improved Mode of Constructing Cast Iron Buildings;* Harriet V. Terry, Administratrix of William D. Terry, deceased, Boston, Mass.

*Claim.*—"Forming cast iron hollow walls for buildings, by means of the combined use of the boxes, plates, and tie-pieces, provided with rebates and tongues for firmly uniting them together."

29. For *Improved Alarm Locks;* S. J. Frank, Guilford Centre, New York.

*Claim.*—"The use of the spring and rod when used in connexion with the plate, arranged and operated as set forth."

30. For an *Improvement in Making Wrought Iron Shafts;* Otis Turfts, Boston, Massachusetts.

*Claim.*—"Constructing large wrought iron shafts with pieces separately wrought and fastened together."

31. For an *Improvement in Machines for Softening Leather;* John B. Wentworth, Lynn, Massachusetts.

*Claim.*—"The combination of the roller by the rotary boarder, and the bar or concave, arranged and made to operate together. Also, the combination of the holding and draft mechanism rollers, with the boarding mechanism or rollers, the boarder and concave or bars, as specified. Also, the napping or filling mechanism, (or roller and bed,) in combination with the boarding mechanism, or the holding and feed rollers thereof. Also, combining with the movable table or bed, the rollers and bed, so that they may be moved simultaneously by either, towards or away from the boarder, the bed, and rollers. Also, when the boarder is made of a series of separate rubbers, springs, and holding frame, applying the sectional rubber to the frame, by means, viz: by a bar, and movable end, whereby the rubbers may be either detached from the frame, or maintained within it."

32. For an *Improvement in Grain and Grass Harvesters;* Abner Whitely, Springfield, Ohio.

*Claim.*—"Constructing the machine, that the driver is enabled, while the team is in motion, and the master wheel shaft being rigidly connected with the main frame, to change the angle of the fingers and cutters without moving the finger bar from the ground."

33. For an *Improvement in Belt Fastenings;* Abner Whitely, Springfield, Ohio.

*Claim.*—"The hook made as described."

34. For an *Improved Movement for the Doctors of Calico Printing Machines;* John Standing, Fall River, Mass., Assignor to self, and James Barandale, Providence, Rhode Island.

*Claim.*—"The combination of the eccentric, the crank, the connecting rod, and lever, so applied to the shaft of the doctor, and made to operate the doctor."

35. For an *Improvement in many-chambered Breech Loading Cannon;* Charles C. Terrel, Shultsburg, Wis., Assignor to self, and Samuel Crawford, Mineral Point, Wisconsin.

*Claim.*—"1st, The combination of lock lever, the wedge and the two, in any manner, for the purpose of forcing up and drawing back the breech to and from the barrel. 2d, The priming tube, combined with the stationary priming magazine to take a new priming therefrom, every time the position of the breech is changed, by attaching it to the lock lever, furnishing it with a wedge or inclined projection 14, to open the valve of the magazine when the lever is raised to unlock the breech. 3d, The combination and arrangement of the hammer, trigger, and main-spring, with a lock lever, which is employed to lock and unlock the breech to and from the barrel."

36. For an *Improvement in the Mode of Attaching Composition Soles to Boots and Shoes;* John W. Wimley, Assignor to self, and Washington H. Penrose, Philadelphia, Pennsylvania.

*Claim.*—"The use of the staples, for the purpose of attaching composition soles to boots and shoes."

37. For an *Improvement in Writing Desks;* Charles H. Bergmann, City of N. Y.

*Claim.*—"Constructing the upper box of writing desks with adjustable or expanding sides."

## FEBRUARY 12.

38. For an *Improvement in Machinery for Cutting Sand Paper;* William Adamson, Philadelphia, Pa.; ante-dated August 12, 1855.

*Claim.*—"The arrangement and combination of the slitting drums, in the manner and for the purpose set forth."

39. For an *Improvement in Scissors;* John Allender, New London, Conn.

*Claim.*—"Making or providing arms to the fulcrum, to vibrate with, and act upon each blade, some distance from the fulcrum, to hold and keep their cutting edges in contact with each other."

40. For an *Improved Method of Tonguing and Grooving Tapering Boards;* B. J. Barber, Balston Spa, New York.

*Claim.*—"The movable bed, with shaft and cutter attached, said bed being operated as described."

41. For an *Improved Wrench;* William Baxter, Newark, New Jersey.

*Claim.*—"Adjusting and securing the jaws of a diagonal wrench by means of the screw and joints."

42. For an *Improvement in Power Looms;* Erastus B. Bigelow, Boston, Mass.

*Claim.*—"The combination of the tension roller, the regulating rod, and the brake or holding lever, when co-operating. Also, regulating the action of the delivery motion by the combined action of the tension roller (or its equivalent), the regulating rod, the pawl or feeler, and the series of catches or stops. Also, the method of holding the tension roller (or its equivalent), whereby the regulating rod *l*, or its equivalent, is griped. Also, the mode of constructing the brake or holding lever, and combining it with the cam, whereby the said holding lever is made to do the double duty of turning the let-off motion shaft, and holding the tension roller, or its equivalent, and whereby also the apparatus which regulates the delivery motion is made to act thereon when the shed is open and the tension roller at rest."

43. For *Machines for Boring and Turning Wood;* Felix Brown and Adolph Brown, City of New York.

*Claim.*—"The support, guiding the extreme end of the boring tool, said support being acted upon by a cam in connexion with springs or weights, in such a manner as to remain stationary, until the boring tool has some little distance entered the wood, and is then made to go backward, in proportion as the wood is pressed forward. 2d, The arrangement and manner of working either the fixed knife or the revolving saw, for the purpose of cutting off the finished work. 3d, The arrangement and manner of working the tools in connexion with the movable slides, attached to the fixed supports, acted upon by their respective cams."

44. For an *Improvement in Ploughs;* John Clark, Washington, D. C., and G. W. N. Yost, Pittsburgh, Pennsylvania.

*Claim.*—"The revolving share cutters attached to the mould board, in combination with the bearing plate or strap, and the extension of the land-side, or the equivalents of said bearing plate, and extension of said land-side, for the purpose of securing the free and certain revolution of the series of revolving share cutters."

45. For an *Improvement in Valves and Exhaust Passages of Steam Engines;* Chas. W. Copeland, City of New York.

*Claim.*—"The manner of increasing the area of the passages for escaped steam, by

means of bars or their equivalents, making part of the valve acting in conjunction with additional apertures or ports in the seat."

46. For an *Improvement in Signals for Vessels;* W. P. Craig and William R. Rightor, Newport, Kentucky.

*Claim.*—"A range of lights placed in the forward part, and in the longitudinal centre of a vessel, the foremast light being the lowest, and the following ones rising in succession above it, so as to present to an observer in or near the line of its course, a range of lights, which is either vertical, or is directed obliquely to starboard or larboard, according to the course of the vessel."

47. For an *Improved Method of Regulating the Feed Gates for Mills, &c.;* Clement Dare, Cincinnati, Ohio.

*Claim.*—"The combination of the floats, rods, beam lever, and sliding bar, and these in combination with the cam lever, shaft, levers, and rods, or their equivalents, for operating the gate."

48. For a *Rotary Planer for Felloes;* C. H. Denison, Green River, Vermont.

*Claim.*—"The combination of the rotary bed, cutter head, and cutter bar."

49. For an *Improvement in Oil Cans;* Levi S. Enos, Orlean, New York.

*Claim.*—"The compact arrangement with each other of the air tube, the discharging tube, the thumb-piece, the spring, the valve rod, and their movable cover of the can, which enables the said operating parts to be easily withdrawn from the can, for examination and repairs, and as easily replaced again for service."

50. For an *Improvement in Devices for Removing Incrustations of Boilers;* William E. Everett and M. Minthorne Thompson, City of New York.

*Claim.*—"The method of softening, or softening and removing the deposit upon boilers commonly known as scale, namely, by exposing the same to the action of steam."

51. For an *Improved Adjustable Carriage Seat;* David N. Flanders, South Royalton, Vermont.

*Claim.*—"The additional revolving seat, hinged upon the bed piece, so that it will turn and assume the two positions described, and thus make the carriage convenient for the accommodation of two or three passengers."

52. For an *Improvement in Railroad Car Axle;* P. G. Gardiner, City of New York.

*Claim.*—"My improved car axle, composed of a sheet of metal wound into a tubular form, with its ends welded to solid journal pieces."

53. For an *Improvement in Gas and Steam Cooking Apparatus;* John S. Gallaher, Jr., Washington, D. C.

*Claim.*—"1st, The construction of gas cooking apparatus, formed as skeleton frame plates, having ventilating slots, or equivalents, and the arrangement therewith of a series of longitudinal and transverse jet tubes or pipes in tiers, together with the compound tubular valve pipes, and the combination of the above devices, with detachable drawer-like or baking apartments. 2d, The construction of the central reservoir heater, and the steam boiler sheet device, as described, and in application and use as set forth. 3d, The compound suspension griddle device, and the ventilating diaphragm vessel, as described. 4th, The air supply bellows, or pump device, and the application and use of the same, as described."

54. For an *Improvement in Sticking Pins in Paper;* Thaddeus Fowler, Waterbury, Connecticut.

*Claim.*—"The use of the form for separating, arranging, and spacing the pins when combined with the paper holder, for the purpose of transferring the pins to the prepared paper ready for sticking, when both are constructed, used, and made to produce the result. Also, the combination of the paper holder with the frame, when constructed, arranged, and used for inserting the pins into the prepared paper."

55. For an *Improvement in Seed Planters;* Robert Gebby and Willian Gebby, New Richland, Ohio.

*Claim.*—"1st, Constructing a corn planter with compound or double graduating feeding valve rod device, having a stirrer pin or spur, and combined in operation with the

actuating lever device, formed with the trigger, and spur, and spring hook, or catch device. 2d, The skimmer fender formed with a hinged flap or pressure plate and adjusting rod."

56. For a *Lubricator;* William Gee, City of New York.

*Claim.*—"A glass cylinder, as described, protected by a brass or other metallic cylinder, with openings to see the oil, and the tube passing up through the oil, which, by radiating its heat derived from the hot steam, keeps the oil in a liquid state under all temperatures. Also, the method of preventing accidents of the glass breaking, by the elasticity of the india rubber above and below the edges of the glass lubricator as packing, as well as the diaphragm of india rubber, as described, the whole in combination as a lubricator or to supply and regulate the flow of oil, and, by sight, enable the person attending to know when the oil or lubricating material is exhausted, and by the method described. By the diaphragm, I do away with the necessity of having ground metallic surfaces which are always getting out of order; this lubricator will answer for supplying vacuum by opening the cock, the air passing up the tube above the oil, which forces the oil out, and making a vacuum lubricator, which I include as part of my claim."

57. For an *Improvement in Power Looms;* Elijah Hall, Rochester, New York.

*Claim.*—"Locking and unlocking the reed by means of sliding bolts applied to the back of the lay, behind the reed, and operated by connexions with the connecting rods by which the lay is driven."

58. For an *Improved Hand Press for Stamping Letters, &c.;* Anson Hatch, Forrestville, Connecticut.

*Claim.*—"So combining the arm which carries the stamp, plate, or form, with the cam, as that by vertical pressure on said arm it shall move over the inking apparatus horizontally or nearly so, to be inked, and then descend vertically on to the bed, to give the impression, and in returning, pass above the inking rolls, so as not to touch them."

59. For an *Improvement in Condensing Steam Engines which are used for Pumping;* Birdsill Holly, Seneca Falls, New York.

*Claim.*—"Leading the eduction steam pipe of a steam engine into the suction pipe of a force or lift pump, whereby the condensation of the steam is effected and a partial vacuum produced without a separate condenser and air pump, and in this, engines employed wholly or in part to raise water without any additional expenditure or loss of power to raise the water to effect condensation."

60. For an *Improvement in Cotton Seed Planters;* J. L. Horn, Edgecomb County, North Carolina.

*Claim.*—"The arrangement of the back and front guards, in combination with the distributing wheel, provided with the flanches, and chargers placed at proper intervals, so that no seed can escape below the horizontal line, except at the proper and lowest point immediately in rear of the opener."

61. For an *Improved Method of Hanging and Adjusting Circular Saws;* Westel W. Hurlbut, Utica, New York.

*Claim.*—"1st, The arms as connected with the bearings and supported by the pins or centres, in connexion with the slide. 2d, The moving of the saw, either sideways or diagonally, by the use of the slide and the bolts, or their equivalents."

62. For an *Improved Elevator for Puddlers' Balls;* Solon S. Jackman, Lock Haven, Pennsylvania.

*Claim.*—"The use of the pulley, lever, and brace, in connexion with the stem or supporter and tilt plate."

63. For an *Improved Wrench;* Ferdinand Keehnold, Bridgeport, Connecticut.

*Claim.*—"The jaws and lever, as constructed, operating in connexion with the ratchet bar."

64. For an *Improvement in Steam Condensers;* James T. King, City of New York.

*Claim.*—"A condensing tank having a vertical partition of any desirable depth, with the inlet steam pipe and a vacuum valve upon one side of the partition above the water,

and the escape steam pipe on the opposite side of said partition, so that the steam before it can escape, must, by its pressure, force the water down one side of the partition and pass up through the water in the other side."

65. For an *Improvement in Sealing Preserve Cans;* R. W. Lewis, Honesdale, Pa.

*Claim.*—"The combination of the projecting ribs with the cap, constructed, combined, and operating substantially in the manner specified."

66. For an *Improvement in Porte-Monnaies;* C. Lindner and C. Hoffmann, City of New York.

*Claim.*—"The application and manner of connecting the inside of the porte-monnaie elastic bands, or india rubber cords, or springs passing through the joint to the inside, so as to be able to attach the same to the finger."

67. For an *Improved Diaphragm Pump;* John L. McPherson, Clinton County, and Jacob O. Joyce, Cincinnati, Ohio.

*Claim.*—"The application to pistons of pumps of a corrugated diaphragm, which admits of greater length of stroke without overstraining the material. Also, in combination with a corrugated diaphragm, the flaring or rounded followers, so that they will approach and take up the folds of the diaphragm in accordance with the length of the stroke given to the piston rod. Also, the wedge-shaped valve, which lies loose in its seat, and rocks on its rounded base to open or close passages."

68. For an *Improvement in Wick Holders for Argand Lamps;* E. Moellen, Newark, New Jersey.

*Claim.*—"Holding the wick and pressing it outwardly against the wick tube, in the manner set forth."

69. For an *Improved Wrench;* Elisha P. Newton, Albany County, New York.

*Claim.*—"The arrangement of a semi-screw thread, cut or counter-sunk in the shank, and the semi-screw threaded stop or catch for working therein, by which means, finer threads may be used and the movable jaw be brought closer up to the nut, and the stop or catch removed out of the way of the action of the wrench, they being arranged and operating in the manner described."

70. For an *Improvement in Grain Harvesters;* Job Phillips, Harrisburgh, Pa.

*Claim.*—"The self-adjusting platform hinged at front, and so governed in its motions at the rear of the short arm of the regulating side lever, or equivalent thereof, as to maintain a fixed distance of the rear part from the ground, while the front part is raised or lowered by the adjusting levers."

71. For an *Improvement in Ships' Compasses;* John Prime, Washington, N. C.

*Claim.*—"The method of constructing the cover of compass boxes by inserting the metallic ring within the rim of the glass with a band of india rubber or other elastic material between, to compensate for the unequal expansion and contraction."

72. For an *Improved Method of Extinguishing Fires;* Lea Pusey, Philadelphia, Pa.

*Claim.*—"The adaptation of the water spouts of buildings to the purpose, by means substantially the same as those described."

73. For *Breech Loading Fire Arms;* William H. Robertson and George W. Simpson, Hartford, Connecticut.

*Claim.*—"The sliding socket breech constructed and operated in the manner described. Also, the flexible spring check to prevent the passage or escape of gas in breech loading fire arms."

74. For an *Improvement in Cultivator Teeth;* C. H. Sayre and G. Klink, Utica, New York.

*Claim.*—"So constructing a cultivator tooth, that when made of thin or sheet metal, a part thereof shall form a tubular shank, whereby said tooth may be drawn up and securely attached to the frame."

75. For *Improved Envelopes for Bottles;* John Luther, Coblenz, Prussia; patented in England, August 29, 1854.

*Claim.*—"The combination of mechanism and the making of envelopes for bottles, as described."

76. For an *Improved Safety Spring Coupling;* Edwin F. Shoenberger, Marietta, Pa.

*Claim.*—"The shape and construction of the coupling, so that the shafts of the carriage can be attached to the axle by merely dropping the ends downwards into the boxes, in a vertical position, and their combination with the spring to prevent noise or rattling."

77. For an *Improvement in Fluing Blast Furnaces;* Christian Skink, State Lick, Pennsylvania.

*Claim.*—"Applying and introducing common salt as a flue or solvent, or its equivalent, into blast furnaces at the tuyere or any point below the tunnel head."

78. For an *Improved Bolt Machine;* Timothy F. Taft, Fitchburg, Massachusetts.

*Claim.*—"1st, The two side punches operating simultaneously and equably upon the opposite sides of the bolt, in combination with the intermittent rotary motion of the bolt holder for the purpose of finishing the bolt head with its centre in the axis of the shank. 2d, The forward and backward motion of the bolt holder, when the rod which ejects the bolt, is supported at a point in advance of that on which the bolt holder vibrates, for the purpose of ejecting the finishing bolt."

79. For an *Instrument for Grating Green Corn;* Banjamin Taylor, Philadelphia, Pa.

*Claim.*—"The flat or concave piece of wood or metal with its opening scraper and one or more rows of spikes, the whole being arranged in the manner set forth."

80. For an *Improved Machine for Folding Paper;* Thomas Thompson, Niversville, New York.

*Claim.*—"The forming block, in combination with the rollers, so constructed and arranged, as to draw the material to be folded, over said block and fold it."

81. For an *Improved Oil Box for Axles with Conical Journals;* William D. Titus, Brooklyn, New York.

*Claim.*—"Constructing the cone or cones made close with an internal oil or grease chamber around a cylinder or tube forming the centre part longitudinally of the cone, and providing the said cone on its periphery, at opposite ends and on reverse sides, with slices or openings."

82. For an *Improvement in Clothes' Clamps;* William H. Towers, Philadelphia, Pa.

*Claim.*—"Forming slits at the upper portion of the clothes' clamps in such a manner, as to give an increased degree of elasticity to the upper portion of the jaws, between which the clothes are clamped, and enable said jaws to be opened sufficiently to admit the clothes and line between the grooves in the same, and to detach them therefrom, without scraping the clothes with the sides of the lower slit, by pressing the prongs formed by the upper slit together."

83. For *Cutter Heads for Planing Machines;* Loison D. Towne, Worcester, Mass.

*Claim.*—"The clamping or holding of the cutters between the brace and sides of the cutter head by means of the conical or wedge-shaped form of the plug and braces, or their equivalents, and whether said head be solid or made in two or more sections."

84. For an *Improvement in Railroad Switch;* James Whitcomb, Detroit, Michigan.

*Claim.*—"The enlargement for the long switch rail, when connected with a short switch bar."

85. For an *Improvement in Railroad Car Couplings;* S. W. Wood, Washington, D. C.

*Claim.*—Constructing the buffers of railway cars in such manner, that the coupling rod may be dropped into its place from the upper surface or sides, said connecting rod consisting of a single piece of wood or metal being independent of, and not in any way fastened to the buffers, while it is retained in position by its own gravity."

86. For an *Improvement in Grain and Grass Harvesters;* George W. N. Yost, Pittsburgh, Pennsylvania.

*Claim.*—"Combining with the cutter bar of harvesters a series of friction rollers, when said rollers are kept constantly pressed down on the cutter bar by means of springs."

87. For an *Improvement in the Construction of Mastic Roofing;* C. C. Hoff, Albany, Assignor to E. P. Russel, Manlius, New York.

*Claim.*—"Preparing the canvas with the soluble and earthy matters in the manner set forth, and then covering the same with tarry resinous material and carbonaceous compound, in the manner set forth."

88. For an *Improved Method of Concaving Circular Saws;* James M. Kern, Morgantown, Virginia.

*Claim.*—"The making of a dish-shaped saw from a flat circular saw plate, by cutting away a portion of the interior of the plate, withdrawing a portion of the remaining metal into the spaces thus cut away, by which the desired concavity may be attained without cutting out to the periphery of the plate."

89. For an *Improvement in Pegging Boots and Shoes;* Alfred Swingle, Assignor to Elmer Townsend, Boston, Massachusetts.

*Claim.*—"The new arrangement of the cutting knife with respect to the peg wood carrier and the peg receiver, so as to operate against the side of the peg wood, and cut into it from side to side. Also, arranging or combining with the cutting knife and the handle, as described, a spring stop or catch, so applied as to operate and retain the knife in position to shut off communication between the feeding trough and the peg receiver under circumstances as stated. Also, arranging in front of the peg receiver and front of the knife a waste receiving and discharging chamber or mouth, the same being made to operate as specified."

90. For an *Improvement in Potato Planters;* Charles Morgan, Assignor to Samuel Emlen, Philadelphia, Pennsylvania.

*Claim.*—"The form and plunger, with its projection, in combination with the hopper, said fork and plunger being operated simultaneously."

91. For an *Improvement in Caldrons;* Henry Neusham, Baltimore, Maryland.

*Claim.*—"Constructing a caldron by giving the bottom thereof an arched form in the manner described."

92. For an *Improved Gearing for Feed Rollers of Planing Machines;* Charles Burleigh, Assignor to the Putnam Machine Company, Fitchburg, Massachusetts.

*Claim.*—"The toothed links constructed and operating in the manner set forth."

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## LAW REPORTS OF PATENT CASES.

For the Journal of the Franklin Institute.

### *Reaper Case.*

### C. H. M'Cormick *vs.* J. H. Manny *et al.*

**The plaintiff's first patent for a reaping machine, being dated in 1834, has expired, and whatever invention it contained, now belongs to the public.**

**Improvements were made by M'Cormick in reaping machines, for which, in 1845, he obtained a patent, and in 1847, a patent for a further improvement, which last patent was surrendered and re-issued in 1853.**

**A machine may consist of distinct parts, and some, or all of those parts may be claimed as combinations.**

**In such an invention, no part of it is infringed unless the entire combination or the part claimed shall have been pirated.**

In his patent of 1845, for improvements in the reaping machine, the plaintiff claimed the combination of the bow **L**, and dividing iron **M**, for separating the wheat to be cut from that which is left standing, and to press the grain on the cutting sickles and the reel. The defendants' wooden divider does not infringe that claim of complainant's patent, which embraces the combination of the bow and dividing iron.

Where the plaintiff's patent calls for a reel-post set nine inches behind the cutters, which is extended forward and connected with the tongue of the machine, to which the horses are geared, it is not infringed by a reel-bearer, extending from the hind part of the machine, and sustained by one or more braces. The only thing common to both devices, is the supporting the end of the reel nearest to the standing grain. In their combinations and connexions, and in everything else the devices are different.

The invention embraced in plaintiff's patents of 1847 and 1853, was not a raker's seat, but it was the improvement of his machine, by which it was balanced, and the shortening of the reel, so that room was made for the raker's seat on the extended finger-bar. This being his invention and claim, to this his exclusive right is limited.

Had he claimed generally, a seat for the raker, the claim would have been invalid by reason of the prior knowledge and use of the raker's seats in reaping machines.

M'Cormick's raker's seat, patented in 1847, was new in its connexion with his machine, but his invention did not extend to a raker's seat differently arranged.

Manny's reaping machine does not infringe either of M'Cormick's patents. The divider and reel bearer used in Manny's machine, being different in form and principle, do not infringe M'Cormick's patent of 1845.

The stand or position for the forker, invented and patented by John H. Manny, is a new and useful improvement, and different in form and principle from M'Cormick's patents of 1847, and 1853.

This was a bill in Chancery, filed in the Circuit Court of the United States, for the Northern District of Illinois, by Cyrus H. M'Cormick against John H. Manny and others, charging them with infringement of his patents for improvements in the reaping machine, dated January 31, 1845; October 23, 1847; re-issued in May 24, 1853.

The defendants filed their answer, setting up various grounds of defence, but relying chiefly on the defence that the reaping machines manufactured and sold by them at Rockford, Illinois, under the name of Manny's reaper, differ in form and principle from the improvements, patented by M'Cormick, and that the raker's stand or position was an improvement, invented and patented by John H. Manny. Issue being joined, a large volume of testimony was taken, showing the state of the art of making reaping machines before and after the date of M'Cormick's patents. The cause standing for final hearing on the Bill, Answer, Exhibits, and Testimony, it was, by agreement of counsel, heard at Cincinnati, in September, 1855, before the Honorable John McLean, Circuit Judge, and the Honorable Thomas Drummond, District Judge of the United States, for the Northern District of Illinois; and was argued for the complainant by Reverdy Johnson and E. N. Dickerson, Esqrs., and for the defendants by Edwin M. Stanton and George Harding, Esqrs.

The opinion of the Court was delivered at Washington, on the 16th of January, by Mr. Justice McLean.

OPINION OF THE COURT.

This is a bill to restrain an alleged infringement of the plaintiff's patent, by the defendants, and for an account.

By consent of parties, the case was adjourned from Chicago to Cincinnati, at which place it was argued on both sides with surpassing ability and clearness of demonstration. The art involved in the inquiry, was traced in a lucid manner, and shown by models and drawings, from its origin to its present state of perfection. And if, in the examination of the cause, the entire scope of the argument shall not be embraced, no inference should be drawn that the Court was not deeply impressed with the artistical researches and ingenuity of the counsel.

It is proper that I should say here, after the close of the argument at Cincinnati, no time was afforded for consultation with my brother judge. At my request he has lately transmitted to me his opinion on the points ruled, without any interchange of views between us, and there is an entire concurrence on every point stated.

Cyrus H. M'Cormick, a citizen of Virginia, represented to the Patent Office, that he had "invented a new and useful improvement in the machine for reaping all kinds of small grain, which improvement was not known nor used before his application, on which he obtained a patent, dated the 21st of June, 1834. As that patent has expired, and whatever of invention it contained, now belongs to the public, no further notice of it, in this place, is necessary.

The same individual, on representing to the Patent Office, that he had invented certain new and useful improvements on the above machine, obtained a patent for those improvements, dated the 31st of January, 1845.

After describing certain improvements in the cutting apparatus, the divider, and the reel-post, he makes the following claims:—

1. The curved (or angled downward for the purpose described,) bearer for supporting the blade in the manner described.

2. The reversed angle of the teeth of the blade, in manner described.

3. The arrangement and construction of the fingers (or teeth for supporting the grain) so as to form the angular spaces in front of the blade, for the purpose designed.

4. The combination of the bow **L**, and dividing iron **M**, for separating the wheat in the way described.

5. Setting the lower end of the reel-post F, behind the blade, curving it at R and leaning it forward at top, thereby favoring the cutting, and enabling him to brace it at the top by the front brace S as described, which he claims in combination with the post.

And afterwards, M'Cormick applied for another patent, for improvements made on his reaping machine, patented in 1845, and it was issued to him the 23d of October, 1847. This patent was inoperative, as the patentee afterwards alleged, by reason of a defective specification; and he surrendered it, and obtained a corrected patent the 24th of May, 1853.

In his specification of this patent, he says, "The reaping machines heretofore made, may be divided into two classes. The first class having a seat for a raker, who, with a hand rake equal in length to the width of the swath cut, performs the double office of gathering the grain to the

cutting apparatus and on to the platform, and then, of discharging it from the platform on the ground behind the machine."

The defects of the first class were remedied, he says, by the second class, in which a reel was employed to gather the grain to the cutting apparatus, and deposit it on a platform, from whence it is raked off by an attendant, who deposits the grain on the ground by the side of the machine, where it can lay as long as desired; the whole width of the swath being left unencumbered for the passage of the horses on the return of the machine to cut another swath.

And he states, that the length of the reel leaves no seat for the raker, who has to walk on the ground at the side of the machine and rake the grain from the platform. And, he says, the weight of the machine is too great back of the driving wheel. For these defects, he has provided a remedy by his improvements, which places the driving wheel back of the gearing that gives motion to the sickle, which is placed in a line behind the axis of the driving wheel; and, the cog gearing which moves the crank forward of the driving wheel, so as to balance the frame of the machine with the raker on it. And, also, in combining with the reel which deposits the grain on the platform, a seat or position for the raker to sit or stand, so that he may rake off the grain thrown upon the platform by the reel, on the side of the machine farthest from the standing grain.

And, in the conclusion, he says, "What I claim as my invention, and desire to secure by Letters Patent, as improvements on the reaping machine, secured to me by Letters Patent dated the 24th of June, 1834, and the 31st of January, 1845, is placing the gearing and crank forward of the driving wheel for protection from dirt, &c., and thus carrying the driving wheel further back than heretofore, and sufficiently so to balance the rear part of the frame with the raker thereon; when this position of the parts is combined with the sickle, back of the axis of motion of the driving wheel, by means of the vibrating lever, substantially as herein described."

And, he claims "the combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the seat or position for the raker, arranged and located as described, or the equivalent thereof, to enable the raker to rake the grain from the platform, and lay it on the ground, at the side of the machine."

The defendants in their answers, deny the validity of the plaintiff's patent for want of novelty, and on other grounds; but in their argument, they disclaim any such purpose; and place their defence on a denial of the infringement charged.

The infringement of the plaintiff's machine by the defendants, is alleged to consist in his divider, reel-post, and its connexions, and the raker's seat.

The fourth claim in the plaintiff's patent of 1845, is, "The combination of the bow **L**, and dividing iron **M**, for separating the wheat in the way described."

He describes the divider as an extension of the frame on the left side of the platform, three feet before the blade, for the purpose of separating the wheat to be cut from that to be left standing, and that, whether tangled

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The fourth claim in the plaintiff's patent of 1845, is, "The combination of the bow **L**, and dividing iron **M**, for separating the wheat in the way described."

He describes the divider as an extension of the frame on the left side of the platform, three feet before the blade, for the purpose of separating the wheat to be cut from that to be left standing, and that, whether tangled

or not. This divider gradually rises from the forward point with an outward curve or bow, so as to throw off the grain to the left, and thus separate it from the grain to be cut. And this is combined with a dividing iron rod or bar, made fast by a bolt to the timber extended as a divider, which bolt also fastens the bow. From this bolt the iron rises towards the reel at an angle of thirty degrees, until it approaches near to it, when it is curved to suit the circle of the reel. This iron is adjustable to suit the lowering or elevation of the reel, by a bolt and slot in the lower end. By its gradual rise, this iron divider elevates the tangled grain, and presses it against the cutting sickles of the machine.

There can be no doubt that this combination of the bow and iron divider as claimed, is new, it not having constituted a part of any reaping machine prior to the complainant's.

In the specifications of the defendant's patents he says, "The divider F, projects on the left side of the machine in advance of the guard fingers; and divides the grain to be cut from that which is to be left standing," &c. And the machine constructed under his patent has a wooden projection somewhat in the form of a wedge, extending beyond the cutting sickles some three feet, and which from the point in front rises as it approaches the cutting apparatus, with a small curve, so as to raise the leaning grain and bring it within the reel on the inner side of the divider, and on the outer side by the projection to disentangle the heads and stalks, so as to leave them with the standing grain.

This is not dissimilar in principle, from the wooden divider of the plaintiff's machine. The curve outward may be less, and the elevation from the point which enters the grain may also be less than McCormick's, but it performs the same office, and in principle, they may be considered the same. And the question necessarily arises, whether, in this respect, this divider is not an infringement of the plaintiff's patent.

A satisfactory answer to this inquiry is not difficult.

The plaintiff claims his wooden divider in combination with the iron rod on the inner side, and which rises from its fastening at the angle of thirty degrees. The adjustability of this iron by giving it a lower or higher elevation, is also important, and would, of itself, be a sufficient ground for a patent. But in this inquiry, the adjustability of the iron divider is not important, as it may be considered stationary.

A patent which claims mechanical powers or things in combination, is not infringed by using a part of the combination. To this rule there is no exception. If, therefore, the wooden divider of the defendants' machine, be similar to that of the plaintiff's, there is no infringement; as the combination is not violated in whole but in part. But there is another, and equally conclusive answer to the objection.

The plaintiff's wooden divider was not new, and, therefore, could be claimed only in combination.

The English patent of Dobbs, in 1814, had dividers of wood or metal. The outer diverging rod of Dobbs' divider, rises as it extends back, and, at the same time, diverging laterally from the point of the divider, acts the same as the McCormick divider of 1845, to raise stalks of grain inclining inwards, and to turn them off from other parts of the machine.

The English patent of Charles Phillips, in 1841, had a dividing apparatus, consisting of a pointed wedge-formed instrument, which extended some distance in advance of the cutting apparatus and reel; its diverging inner side, like the corresponding side of M'Cormick's divider, of 1845, bears inward upright grain within the range of the reel and cutting knives; while at the same time its outer diverging edge, like the outer edge of M'Cormick's divider, bears off standing grain without the range of the reel. And there is an inclined bar, which being attached by its front to the lower piece, extends backwards and upwards, until it meets the frame of the machine, at a point above and behind the cutting apparatus. Ambler's machine had also a divider not dissimilar to the defendant's.

Bell's machine, made in 1828, had dividers on it to press the grain away from the machine on the outer side, and on the inner side to press it to the cutters. Hussey's machine, too, had a point which projected into the grain and dividing it, before the cutting knives, the inside to be cut, the outside to remain with the standing grain.

In Schnebly's machine, the grain to be cut was separated from that which was left standing, by a divider projecting on the side of the machine.

In the plaintiff's patent of 1834, he says, "on the left end of the platform is a wheel of about fifteen inches diameter set obliquely, bending under the platform to avoid breaking down the stalks, on an angle that may be raised or lowered by two movable bolts, as the cutting may require, corresponding with the opposite side. The projection of the frame at this end is made sufficiently to bear off the grain from the wheel." And he claims, "the method of dividing and keeping separate the grain to be cut from that to be left standing."

This patent having expired, whatever of invention it contained, now belongs to the public, and may be used by any one.

The inner line of the projecting divider of the defendants' machine, it is contended, has a gradual rise from the point, which answers the purpose of the iron divider of M'Cormick's, to crowd the grain on the reel and cutters; but, in this respect, the wooden divider of the defendant is not materially different from those above referred to and others in use, before the plaintiff's patent of 1845.

In regard to the divider, in the defendants' machine, it is clear, that it cannot be considered as an infringement of the plaintiff's patent.

The reel-post, as claimed, with its connexions, by the plaintiff, seems not to have been infringed by the defendants.

In defendants' machine, the end of the reel, next the standing grain, is supported by an adjustable arm, which is nearly level, slightly inclined upwards, and supported by a standard towards the rear of the machine. In M'Cormick's patent of 1845, the reel-post is set back of the cutter some nine inches at its foot, rising upwards, and projecting forwards, and supported at its top by a brace running to, and connected with, a standard on the tongue of the machine. The reel-post of the defendant is substantially like the one in Bell's reaping machine, and also the patent granted to James Ten Eyck, in 1825. The reel-support or bearer of the latter has not the features of vertical and horizontal adjustability con-

tained in the reel-bearer of the defendants; but it is attached to the machine behind the platform on which the cut grain is received, and it extends forward to hold the reel and to leave the space beneath it unobstructed.

In his patent of 1834, M'Cormick placed his reel-post before the cutting apparatus, standing perpendicularly and being braced as described. But, in the patent of 1845, that post was set nine inches behind the sickles, leaning forward so as to bring the part of it which supported the reel to its former perpendicular, the post still extending forward so as to admit of being braced directly to the tongue of the machine, to which the horses are harnessed.

This was rendered necessary, as the first post being in advance of the cutters, encountered the fallen grain which adhered to it, and clogged the machine.

The reel-posts, so-called, in both these machines were alike only, as bearers of the end of the reel next to the standing grain; but their structures in every other respect, are different. M'Cormick's reel-post served as a brace to the machine, its foot being mortised into the left sill of the machine, nine inches behind the cutting sickles, its top leaning forward was braced to the tongue of the machine. The defendant's reel-post, like that of Bell's, was connected with the hindmost part of the machine, and was sustained by braces as the reel-bearer. In giving strength to the machine, it was unlike the plaintiff's, and if this were not so, the defendant's is sustained by similar reel-posts in other machines prior to M'Cormick's. But, in addition to these considerations, the plaintiff claims his reel-post in combination with the tongue of the machine as described. There is no pretence that this combination has been infringed.

From the structure of M'Cormick's reaper, it was impossible to find a seat for the raker, without an adjustment of the machine, which should balance it with the weight of the raker behind the driving wheel. For this purpose the gearing and crank were placed further forward, the finger-piece was extended, and the reel shortened so as to make room for the raker, and enable him to discharge the grain at the side of the machine, opposite to the standing grain. This improvement was claimed, as a combination of the reel with the seat of the raker.

In his specifications to the patent of 1853, M'Cormick describes two classes of machines. The first class having a seat for a raker, who, with a hand rake having a head equal in length to the width of the swath cut, performs the double purpose of gathering the grain to the cutting apparatus, and on to the platform, and then of discharging from the platform behind the machine. This was defective principally, he says, because the grain was discharged behind in the wake of the machine, rendering it necessary to remove the grain before the return of the machine, and he alleges these defects are obviated by his improvement.

In the defendant's specifications to his patent of the 6th of March, 1855, he says, after referring to M'Cormick's, Schnebly's, Woodward's, and Hite's machines, in regard to the seats of the rakers, "The improvement of mine consists, in combining with the reel which gathers the grain to the cutting apparatus, and deposits it on the platform, a seat or position arranged between the inner end of the platform and the end of

the machine next the standing grain, for an attendant to sit or stand on, and which gives due support to him while operating a fork to push the cut grain towards the outer end of the platform, where the grain is first compressed against the wing or guard provided for the purpose, and then, by a lateral movement of the fork discharged properly on the ground behind the platform in gavels, ready to be bound into sheaves."

And in summing up, the defendant says, "What I claim is the combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the stand or position of the forker, arranged and located as described, or the equivalent thereof, to enable the forker to fork the grain from the platform and deliver and lay it on the ground at the rear of the machine as described.

With a few verbal alterations, this claim is the same as made by the plaintiff, with exception of the seat of the raker, and the place of deposit for the grain.

It must be admitted that the combination of the raker's seat with the reel, as claimed by the plaintiff, was new; and a very important question arises how far this claim extends; is it limited to the mode of organization specified, or may it be considered as covering the entire platform of the machine, and all combinations of the seat and reel?

The reel was not new; nor was a seat on the platform, or connected with the platform for the raker, new; but the position for the raker *as described* by M'Cormick, was new. Mr. Justice Nelson, in the case of M'Cormick *vs.* Seymour and Morgan, in his charge to the jury, said, "the seat was the object and result he was seeking to attain by the improvement which he supposed he had brought out. What he invented was the arrangement and combination of machinery which he has described, by which he obtained his seat. That, and not the seat itself, constituted the essence and merit, if any, of the invention."

The reel was advanced in front of the cutters and shortened, and the driving wheel was put back; and the gearing forward, so as to balance the machine with the weight of the raker on the extended finger-piece. In this peculiar organization, the improvement of M'Cormick consisted. It was adapted to no other part of the machine. To place the raker on any other part of the platform or machine of M'Cormick than on the extended finger-board, would derange its balance, which was so well adjusted by the improvement described. No such change can be made without experiment and invention, consequently, the improvement of the plaintiff, in this respect, is limited to his specification.

In 1844, Hite made a new and useful improvement on M'Cormick's reaping machine, patented in 1834, by attaching thereto a seat, mounted on wheels for a raker to occupy, when raking the grain from the platform, on which it is deposited by the reel. And a patent was issued in 1855, for this improvement, although, from the evidence, the presumption was, that the improvement had gone into public use more than ten years.

William Schnebly, at Hagerstown, from 1825 to 1837, constructed reaping machines. At first a revolving apron was used, but this was discontinued, and after the grain had been thrown on the platform by the reel and the proper motion of the machine, he says, "He sat upon the machine in rear of the platform, sometimes upon the guard board and

sometimes astride a cap or cross-beam suitable for that purpose, and raked off the grain with a three or four-pronged fork from the platform and deposited it on the ground at the side of the machine."

In the specifications of Woodward's machine, patented in 1845, he says, "The raker stands upon the platform, L, and, as the grain is cut and falls upon the platform, he, with a fork or rake, conveys it to the hinged box, and when a quantity is accumulated therein sufficient, the rear end of the box falls and deposits the wheat on the ground in the form of a gavel." This box was often dispensed with. The raker rode on the machine.

In 1844, Nicholson represented that he had made an improvement on a machine for cutting grain, &c., and he says, "The machine is provided with a pair of shafts, L, for the animal to draw by, and a place, A, for the driver to sit on, and a suitable stand for a raker's seat." And as a part of his improvement, he claims a mode of depositing the grain in a line out of the track of the horse, as described. In 1855, a patent was issued for this improvement to the administrator of Nicholson.

In Abraham Randall's patent, dated in 1833, the grain was raked off the machine by a raker who had a seat on the platform. This part of the machine succeeded well. When a sufficient amount of grain was collected on the platform to make a sheaf, it was raked off the side. The machine was in use several years.

The platform of the defendant's machine is different from that of the plaintiff's. The latter is constructed, so that the side next to the reel and the cutting knives, is parallel with them, whilst Manny's platform is so constructed, as to extend back from the cutters in a diagonal form, which brings its hindmost part, through which the grain is discharged, to the right of the swath cut. This leaves the way open for the machine in cutting the next swath. The raker in this machine, occupies a place behind the running ground wheel at the rear of the divider with his face quartering to the horses.

Whether we look at the structure of the platforms or the position of the rakers, no two things could be more unlike than the two machines of the plaintiff and defendants. Do they differ in principle as well as in form? To provide for M'Cormick's raker, the structure of the machine had to be altered materially by changing the heavy machinery, so as to balance it with the weight of the raker on the extended finger-board. The reel had also to be shortened.

On Manny's machine the raker occupies a place diagonal to that of M'Cormick's, and at the farthest part of the platform next to the standing grain. He stands not upon the extended finger-board, but on the platform, requiring no shortening of the reel nor balancing of the machine.

From the patents above referred to, it appears that before the last improvement of M'Cormick, rakers had been placed upon the machines, intended to perform the same office as M'Cormick's raker. It is no answer to this fact to show that some of these plans were abandoned or superseded by the progress of improvement. They were embodied in patents and were not only publicly constructed and used, but the models of the machines were deposited in the Patent Office, and the patents, with their specifications and drawings, were matters of public record.

Now, if these various plans of seating a raker on the machine, as called for in other patents prior to that of M'Cormick's, did not affect the validity of his subsequent patent, it could hardly be contended that his patent excludes all subsequent improvements for a raker's seat. In the case of M'Cormick *vs.* Seymour and Morgan, Mr. Justice Nelson argues very properly in saying, "It is insisted on the part of the learned counsel for defendants, that there is nothing new in this, because there is in the machine of Hussey a seat, or, what is equivalent, a position for the raker, in which he may stand and rake off the grain. The seat, that is, the position on the platform, is, in one sense, undoubtedly common to both. But Hussey's machine has no reel to interfere with the raking, and the grain, instead of being raked from the platform, is pushed from the back part of it. The question is, whether the arrangement of the seat, the combination by which the patentee obtains and can use the seat or position, is similar to, or substantially like, the contrivance in Hussey's machine; that is the point. The mere fact that a seat was used in previous reapers, does not embrace the idea contained in this patent. That view could only be material under the assumed construction given by the learned counsel for the defendants to the patent that it is for a seat. If that were the thing invented and claimed by the patentee, then the seat of Hussey would be an answer to the claim."

"There is, also, another point," says the learned judge, "to which it is proper to call your attention in this connexion, and which has been the subject of discussion by the counsel, and that is, that Hussey, in the construction of his machine, in Ohio, at a very early day, used a reel in connexion with his cutter and a raker. It is insisted that this use of the reel, in connexion with a raker in Hussey's machine before the discovery of the plaintiff, destroys his claim to originality. In answer to this it is claimed, on the part of the counsel for the plaintiff, that the contrivance of Hussey, into which the reel was introduced, was substantially different from the plaintiff's contrivance. It appears that Hussey's reel, like the reel of the plaintiff, when his first seat was put on in 1845, interfered with the raker, so as to prevent his raking the grain the whole length of the platform. Hence, Hussey had an endless apron by which the grain, when cut, was deposited at the feet of the raker, so that he could shove it off with his rake."

I have cited largely from the learned judge, not only because the opinion was greatly relied on by the plaintiff's counsel in the argument of this case, but for the reason that the opinon is sound. The reel, it seems, interfered with Hussey's plan, which was obviated by an endless apron. M'Cormick dispensed with the apron by putting back the driving wheel, and placing forward the gearing, &c., so as to balance the machine, which, with the shortening of the reel, completed his improvement.

Now, if a raker be seated on a different part of the machine, and where he can rake without balancing the machine, and without interruption from the reel, it is a contrivance and an invention substantially different from M'Cormick's. To seat the raker on Manny's machine, does not require the same elements of combination that were essential in M'Cormick's invention. His invention, in procuring a seat for the raker, being new and

useful, was unaffected by those which preceded it. But Manny's contrivance required no such modification and combination of the machinery for a raker's seat as M'Cormick's; it is, consequently, substantially different from his. The seat was not the thing invented, but the change of the machinery to make a place for it. And when the seat may be placed on the platform or on any part of the machine which does not require substantially the same invention and improvement as M'Cormick's, there can be no infringement of his right.

In M'Cormick's claim for the improvements which gave him a seat for the raker, "arranged and located as described," he adds, "or the equivalent thereof."

The words of this claim, "or the equivalent thereof," cannot maintain the claim to any other invention, equivalent or equal to the one described. This would be to include all improvements or modifications of the machine, which would make it equal to M'Cormick's. This part of the claim cannot be construed to extend to any improvements which are not substantially the same as those described, and which do not involve the same principle. It embraces all alterations which are merely colorable. Such alterations in a machine afford no ground for a patent.

As stated by Mr. Justice Nelson, the improvement of M'Cormick, consisted, not in the seat for the raker, but in the modification and new combination of parts of his machine, so as to secure a place for a seat. Had a construction of the seat, merely, been the invention, that learned judge admitted, the prior seat for the raker on Hussey's machine, would have nullified the claim.

Having arrived at the result, that there is no infringement of the plaintiff's patent by the defendants, as charged in the bill, it is announced, with the greater satisfaction, as it in no respect impairs the right of the plaintiff. He is left in the full possession of his invention, which has so justly secured to him, at home and in foreign countries, a renown, honorable to him and to his country, which can never fade from the memory so long as the harvest home shall be gathered.

The bill is dismissed at the costs of the complainant.

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## MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

### *Mechanical Engineering as applied to Farm Implements.* By H. Howson, Civ. Eng.

(Continued from page 141.)

The irregular forms presented by potatoes when cut and prepared for planting, render the adaptation of labor saving machinery to that tedious operation, a matter of no little difficulty.

Nearly all other seeds used by farmers are comparatively uniform in size and figure, and consequently, readily discharged through orifices at suitable intervals by arrangement of stops and valves; hence the variety of planting machines to be found in every section of the country, for

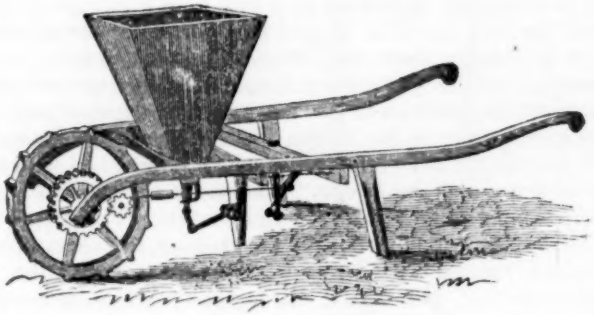
depositing every other description of seed in the ground, excepting potatoes.

### *Morgan's Potato Planter.**

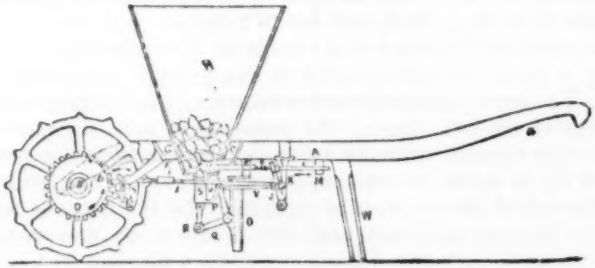
Mr. Charles Morgan, of this city, in directing his attention to, and experimenting upon, machinery for planting this important farm produce, discovered that by sticking a three pronged fork into a bucket full of potatoes prepared for planting, seldom if ever more than one cutting at a time adhered to it. This discovery paved the way to the completion of the implements here illustrated; an implement at once simple and ingenious, and well-deserving of the patent granted to the inventor on the 12th of February last.

In the annexed perspective and sectional view

A A, are the two side frames of the machine, furnished at one end with handles *a*, similar to those of an ordinary wheel-barrow, and at the other end, with boxes for the journals of the axle B, on which is secured a



wheel having on its periphery a series of pointed projections for maintaining a hold on the ground. On the axle B, is secured a toothed wheel D, gearing into the pinion E, which runs loose on a pin secured to a



hanger which is suspended from the cross-piece C. Two of these cross-pieces connect the opposite frames A together, and are beveled for receiving the hopper H. To the wheel E, and at a suitable distance from its

* Manufactured by Messrs. Paschall Morris & Co., the extensive builders of farm implements in this City, and in Reading.

centre, is secured a pin, to which is connected the end of the rod I, the latter having a nut with left and right handed thread for lengthening and shortening the said rod. The opposite end of this rod is connected to a pin in a lever J, which vibrates on a stud secured to the bottom of the hanger K, on a cross bar of the frame.

The top of the lever J, has an oblong eye, through which passes the horizontal rod L, the latter being guided at one end by passing through a cross-bar M, secured to the frame A; the other end is furnished with a fork having three prongs, and these prongs pass through and are guided by another cross-bar N, also attached to the frame A. The eye of the lever J is confined between a collar on the horizontal rod L, and a spiral spring which surrounds the said rod and bears against the collar formed by the termination of the forks.

To the cross-bar N is secured a tube or runner O, in front of which is a lug for receiving a pin, to which is secured the lever P, on the opposite side of the lug and to the same pin is attached another lever Q, the end of which is connected by means of a link R, to a plunger S, which fits in a tube at the bottom of the hopper H. The latter has an opening at the bottom in order to allow the prongs of the fork to have free access to the interior, and the plunger S is furnished with a curved projection U, which at certain intervals in the movement of the machine, is raised across the said opening at the bottom of the hopper. To the end of the lever P, is jointed the rod V, the end of which is furnished with a slotted eye adapted to a pin on the lever J. The frame A, is furnished with legs W, after the manner of an ordinary wheel-barrow. The hopper H being filled with potatoes, cut and prepared for planting, the operator takes the handles *a*, and raising the legs, wheels the machine over the ground, causing the wheel C, and with it the toothed wheel D, to revolve, this communicates motion to the pinion E, and through the rod I, a vibrating motion to the lever J, and a horizontal reciprocating motion to the forked rod, causing the prongs at the end of the latter to be moved in and out of the hopper H. Simultaneously with this movement, the plunger S is caused to be raised up and down in the tube of the hopper by the rod V, connected to the lever J, and levers P and Q.

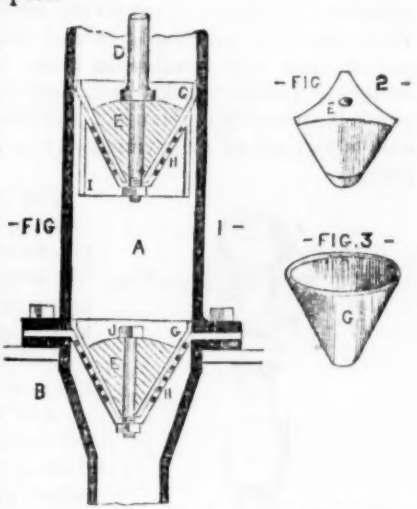
As the machine is shown in the sectional view, the fork is about withdrawing a piece of potato, which it has previously pierced, from the hopper. The continued backward movement of the horizontal rod draws the prongs of the fork through the cross-bar N, until the piece of potato coming in contact with the latter, is released from the point of the fork and drops down the tube O, into the bottom of the furrow. The slot at the end of the rod V, is so regulated that the latter as well as the plunger S, remains stationary until the potato at the end of the fork is nearly clear of the opening of the hopper, when the plunger S, is suddenly raised, stirring up the potatoes in the hopper; at the same time the carved projection also rises covering the opening of the hopper and preventing the potatoes dropping therefrom. On the return movement of the fork, however, the projection U is withdrawn from the opening, so as to allow room for the fork to penetrate the hopper. It will be seen that the distance apart at which the pieces of potato are dropped into the furrow, will be regulated by the diameter of the pinion E, compared

with that of the wheel D, so that by removing the pinion E, and replacing it by a larger or smaller one, the pieces of potatoes may be dropped into the furrow at any distance apart required.

*Weis and Ran's Farm Pump.*

This invention, for which a patent was granted to Joseph Weis, of Bordentown, N. J., in December, 1855, is not applicable to farm uses alone; as a simple pump, however, and one easily repaired, it is particularly well adapted to general agricultural purposes, and as such is well worthy of a place in these papers.

In the annexed engraving, fig. 1, is a sectional elevation of part of an ordinary pump barrel, with Weis's improved buckets and valves. Figs. 2 and 3, are detached views of portions of the latter.




A is the barrel; B the cistern of water; I, is a light cylindrical piece of metal, somewhat less in diameter than the box of the barrel: to this cylinder is secured the perforated metal cone H, inside which is placed a cone-shaped piece of leather, gutta percha, india rubber, felt, or other similar substance represented in fig. 3. This elastic cone G, is so arranged that its upper end shall fit the bore of the barrel A, and inside the cone is placed a three-winged block E (fig. 2). Through the latter is bolted the end of the pump rod D, in such a manner as to secure the cylinder I, perforated metal cone H, elastic cone G, and block E, together. The above forms the bucket of the pump. The valve is constructed in nearly a similar manner; the cylinder I, only being dispensed with, and the perforated cone H, secured between the flanch of the barrel and that of the suction pipe, and the block E, and elastic cone C, attached to the perforated cone by a simple bolt J.

On the descent of the bucket, the water in the barrel passes through the perforations in the cone H, and through the annular space between the barrel and cylinder I, causing the elastic cone G, to collapse into the spaces between the wings of the block E, and allowing a free passage for the water to the upper portion of the barrel. Immediately on the bucket being raised, however, the elastic cone instantly recovers itself, and pressing against the sides of the barrel prevents the return of the water, and at the same time becomes a sucker of the most efficient kind. The action of the elastic cone in the valve is too similar to that in the bucket to need further description. The claim is, "the wedge-shaped block E, with any convenient number of wings, in combination with the perforated hollow cone H, and its similarly shaped piece of gum elastic

or other similar substance G, arranged and constructed substantially as herein specified, the same to be applied as buckets and valves for pumps."

(To be Continued.)

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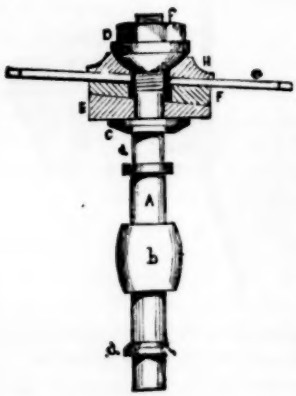
For the Journal of the Franklin Institute.

## *Harrison and Highfield's Adjustable Circular Saw for Cutting Grooves.*

By H. Howson.

Although the present mode of cutting grooves in wood for building purposes, by means of revolving cutters of the same width as the desired groove, is most rapid as well as generally efficient in practice, it is nevertheless objectionable in many respects. The tendency of such cutters to become quickly dull, their liability to break, as well as the expense necessarily involved in preparing and fitting them up with due exactitude, are all evils which detract from the merits they undoubtedly possess.




The arrangement of circular saw and spindle adapted for cutting grooves, as represented in the annexed engraving, exhibits no little ingenuity on the part of the inventors and patentees, Messrs. Harrison and Highfield, of this city, and possesses as well the important qualities of simplicity, cheapness, and efficiency.

A is the spindle, of which *a a* are the journals, and *b* the pulley for receiving the driving strap. C, is a collar forged to, and turned perfectly true with the spindle. To a short distance beyond the collar, the spindle is continued plain, and the remaining portion *f*, is screwed for receiving the nut D. Against the collar C, rests the beveled washer E, fitting easily on the plain portion of the spindle beyond the collar. F, is a second and similar beveled washer, having an orifice somewhat larger than the spindle; against the face of this second washer rests the circular saw G, outside which is a third washer H, having a concave recess for receiving the convex end of the nut D.

When the thinnest portion of the edge of the beveled washer E, is placed so as to coincide with the thickest portion of the edge of the washer F, the face of the saw will be at right angles to the spindle A; but when the relative positions of the two washers are changed, the saw becomes more or less oblique, with the spindle, the amount of obliquity being regulated by the turning of the washers; and consequently, the width of the groove cut into the wood submitted to its action may be regulated at pleasure.

On the edge of one of the washers is cut a dial, and on the edge of the other a notch acting as the pointer; the several marks on the dial indicating that when moved so as to coincide with the pointer, the saw will be at such an angle with the spindle, as to cut a groove of a stated width.

For the Journal of the Franklin Institute.

## *Particulars of the U. S. Steam Frigate Niagara.*

Hull designed by George Steers, Esq., and built at U. S. Navy Yard, Brooklyn. Machinery by Pease & Murphy, New York.

HULL.—

| | | | |
|---|---|---|---|
| Extreme length from taffrail to figure head, | | 345 feet. | |
| Length on deck, from fore part of stem to after part of stern post above the spar deck, | | 337 " | |
| Breadth of beam at midship section, (molded) | | 53 " | 8 inches. |
| " " " " (extreme) | | 55 " | |
| Depth of hold, | | 23 " | |
| " " to spar deck, | | 31 " | 3 " |
| Length of engine and boiler space, | | 100 " | |
| Draft of water at load line, | | 23 " | |
| " " below pressure and revolutions, | | 23 " | |
| Tonnage, | 4750. | | |
| Area of immersed midship section at above draft, | | 911 sq. feet. | |
| Contents of bunkers in tons of coal, | 1000. | | |
| Ratio of length to breadth on load line, | 5979. | | |
| Height of port sill above load line, | | 14 feet | 10 " |
| Distance of dead flat abaft middle of length on load line, | | 7 " | 3 " |
| Centre of buoyancy " " | | 8 " | 7¼ " |
| " of gravity of displacement below load line, | | 8 " | |
| Molded displacement at 23 feet draft, | 5110 tons. | | |
| Total, " " | 5440 " | | |
| Area of load water line, | | 12,755 sq. feet. | |
| Meta centre above load line, | | 5 feet | 6 inches. |
| Moment of stability, ($8\frac{3}{4}$ $y^5$ d $x$,) | 2415560. | | |
| Weight of hull, | 2750 tons. | | |
| " " iron bolts in hull, | 400,000 lbs. | | |
| " " galvanized iron and spikes, | 130,000 " | | |
| " " copper bolts, | 25,000 " | | |
| " " composition bolts, | 16,000 " | | |
| " " Diagonal iron braces, | 169,000 " | | |
| Armament, 12 eleven-inch pivot-guns, probable weight of each, | 2,700 " | | |

ENGINES.—Horizontal—cross-head—double-piston.

| | | |
|---|---|---|
| Diameter of cylinders, | three of | 72 inches. |
| Length of stroke, | | 3 feet. |
| Pressure of steam in pounds, | 20. | |
| Cut-off at | $\frac{3}{8}$. | |
| Revolutions per minute, | 40. | |
| Weight of engines, extras, tools, &c., *in tons*, | 315. | |

BOILERS.—Four—vertical return tubular.

| | | | |
|---|---|---|---|
| Length of boilers, | | 11 feet. | 6 inches. |
| Breadth " | | 21 " | |
| Height " exclusive of steam chimney, | | 15 " | 6 " |
| " " inclusive " " | | 18 " | |
| Weight of " without water, *in tons*, | 285. | | |
| Number of furnaces, | 6 in each. | | |
| Breadth of " | | 2 " | 10½ " |
| Length of grate bars, | | 7 " | 4 " |
| Number of tubes in each boiler, | 2040. | | |
| Internal diameter of tubes, | | | 1¾ " |
| Length of tubes, | | 3 " | 3 " |
| Heating surface, (fire and flues,) | | 17,500 sq. feet. | |
| Diameter of smoke pipes, (two,) | | 7 feet. | |
| Height, | | 60 " | |
| Description of coal, | Bituminous. | | |
| Combustion, | Natural draft. | | |

PROPELLER.

| | |
|---|---|
| Diameter of screw, | 18 feet 3 inches. |
| Length of blades, | 4 " 8 " |
| Number " | two. |
| Pitch of screw, | 29 " 6 " |

*Remarks.*—Frame of live oak. Floors, *molded* 20½ ins., and 8 ins. at heads; *sided* 15 ins. Distance of frames apart *at centres*, 40 ins., and filled in solid to a line six feet above base line with live oak.

| | | |
|---|---|---|
| Weights. | Spar, rigging and sails, | 225 tons. |
| " | Armament, | 257 " |
| " | Stores, | 326 " |

C. H. H.

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For the Journal of the Franklin Institute.

## *Particulars of the Steamer Persia.*

Hull and Machinery built by Robert Napier & Sons, Glasgow. Intended service, New York to Liverpool.

HULL.—

| | |
|---|---|
| Length on deck. | 376 feet. |
| " load line, | 360 " |
| Breadth of beam at midship section, | 45 " 3 inches. |
| Depth of hold. | 22 " |
| " " to spar deck, | 30 " |
| Length of engine and boiler space, | 115 by 45 " |
| Draft of water at load line, | 23 " 6 " |
| " " below pressure and revolutions, | 18 " |
| Tonnage, English, engine-room, 1221, " " deck cabin, 200, " " hold, 2079, | 3500. |
| Contents of bunkers in tons of coal, | 1400. |
| Masts and rig—barque. | |
| Weight of vessel, | 5400 tons. |
| " hull (launching draft), | 2200 " |

ENGINES.—Side Lever.

| | |
|---|---|
| Diameter of cylinders, | 100 inches. |
| Length of stroke, | 10 feet. |
| Maximum pressure of steam in pounds, | 21. |
| " revolutions per minute, | 18. |

BOILERS.—Eight—Horizontal Tubular.

| | |
|---|---|
| Number of furnaces, | 40. |
| Description of coal, | Bituminous. |
| Combustion, | Natural draft. |
| Consumption of coal per hour, | 4½ tons. |

PADDLE WHEELS.

| | |
|---|---|
| Diameter, | 40 feet. |
| Length of blades, | 10 " 8 inches. |
| Depth, | 36 " |
| Number, | 38. |

*Remarks.*—Frame of wrought iron plates $\frac{5}{16}$ to $\frac{11}{16}$ths thick. Floors (I) molded 10. Sided $\frac{9}{16}$ and 6½. Distance of frames apart *at centres*, 18 to 20 inches. Has six water-tight bulkheads. The frames do not rest upon the keel, consequently, the only connexion between the keel and frames, is that of the garboard strakes.

Has accommodations for 200 passengers; and carries 1200 tons freight.

The above dimensions differ essentially from any yet published. They are believed to be correct. C. H. H.

For the Journal of the Franklin Institute.

## *Particulars of the Steamboat Morning Star.*

The engineers of Pittsburgh, Pa., are fitting eight boats with machinery of the usual kind and proportions common to the Western rivers. Seven of them are intended to run during the times of extreme low water, and have stern wheels with the engines connected at right angles.

Nearly all have a small steam engine, termed *the nigger*, and boiler, to be used for hoisting cargo, and for the peculiar operation known as *sparring;* in which the boat is lifted bodily over the shoals by means of tackle attached to each side of the hull near the bow, and to the upper ends of two spars whose lower ends are planted on the bar upon which the boat is grounded; by their means the bow of the boat is raised clear of the ground, when the paddle-wheel is put in motion, urging the boat forward until again a-ground, when the process is repeated until the bar is passed over. Sparring used to be performed by manual power, but the slowness of the mode, with its greater expense, owing to the number of men required, and the great danger to life and limb, has caused it to be superseded by *the nigger*.

The details of one boat only, could be obtained from reliable sources, and they are herewith presented to the readers of the *Journal*.

—

Hull built by W. B. Walker. Machinery by A. Irwin & Co. Owners, Messrs. Brierly & Weaver. Intended service, Missouri River.

HULL.—

| | | |
|---|---|---|
| Length for tonnage, | 210 feet. | |
| " on deck, | 227 " | |
| Breadth of beam at midship section, | 34 " | |
| Depth of hold, | 6 " | 6 inches. |
| Shaft, forward of stern post, at deep load line, | 75 " | |
| Draft of water at deep load line, | 6 " | |

ENGINES.—Slightly inclined.

| | | |
|---|---|---|
| Diameter of cylinders, | | 25 inches. |
| Length of stroke, | 7 feet | |
| Maximum pressure of steam in pounds, determined by law for boilers of the below diameter, | 144·37. | |
| Cut-off at | ½. | |
| Maximum revolutions per minute, (estimated,) | 20. | |
| Weight of engines *in pounds*, | 160,000. | |

BOILERS.—Four—cylindrical.

| | | |
|---|---|---|
| Length of boilers, | 28 feet. | |
| Diameter " | 3 " | 4 inches. |
| Height " above deck exclusive of steam drum, | 7 " | 3 " |
| Weight of " *in pounds*, | 33,600. | |
| Number of furnaces, | 1. | |
| Breadth of " | 15 " | 5 " |
| Length of grate bars, | 4 " | |
| Number of flues or tubes, | 8. | |
| Internal diameter of flues or tubes, | | 15 " |
| Length of flues or tubes, | 28 " | |
| Heating surface, | 1792 sq. feet. | |
| Diameter of smoke pipes, | 5 feet. | |
| Height " | 60 " | |
| Description of coal, | Bituminous. | |
| Draft, | Natural. | |

Consumption of coal per hour, estimated, 2500 pounds.

PADDLE WHEELS.—

| | | |
|---|---|---|
| Diameter, | 28 feet. | |
| Length of blades, | 10 " | |
| Depth, | | 28 inches. |
| Number, | 18. | |
| Dip of wheels at load line, | 3 " | |
| Average revols. per min., estimated, | 20. | |

*Remarks.*—Hull of light build for shoal water navigation.

Accommodations for one hundred second class passengers on the main deck. Upon the hurricane deck is the dining saloon, which is elegantly ornamented with gilded carved work, and lighted with windows of stained glass. On each side are twenty-five state rooms, containing berths for two hundred passengers. The *doctor engine* works four pumps; two for supplying the boilers, one for the bilge water, and the other for extinguishing fire. Two other pumps, worked by hand, may be used for bilge water, washing decks, or for putting out fires. W. J.

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Translated for the Journal of the Franklin Institute.

## *Notes from the Academy of Sciences at Paris.*

*Poisoning by Paint.*—M. Marchal de Calvi has experimentally demonstrated, that the cases of poisoning by remaining in newly painted rooms, are not due, as has been hitherto supposed, to the white lead, but to the vapors of oil of turpentine. According to him, the effects will be the same, whether the paint employed be lead, zinc, or other, so long as the oil of turpentine or any of its analogues is employed as the medium. He compares this kind of poisoning to that which is due to the emanations from flowers, and proposes to treat it by the energetic employment of stimulants.

*Discharge of Acid Vapors from the Chimneys of Manufactories.*—MM. Ch. and Al. Tissier propose to prevent the discharge of acid vapors from the chimneys of manufactories by passing the vapors of the furnace through a lime-kiln. The heat of the kiln helps the draft of the furnace and promotes the absorption of the acid by the lime. The idea is certainly a fruitful one, and may be, in many cases, so applied as to add a new valuable product to the manufactory.

*Newton's Rings.*—M. Carrere reproduces Newton's rings by letting fall upon a surface of water, a drop of the solution of bitumen of Judea, in a mixture of benzine and naphtha. The colors at first change rapidly, but finally become fixed, by the solidification of the film through oxidation. The film may be then fixed on paper, by laying the sheet below it, in the water, and gradually drawing off the water, as is done in pressing seaweeds. To render the film more coherent, and thus the colors more regular, a little caoutchouc is mixed with the bitumen. The same phenomenon may be very brilliantly shown by exposing to the air, warm and recently filtered ink, in which sugar is the cohesive ingredient. In this case, as the thickness of the film, which forms on the surface of the ink, increases very slowly, the order of the colors is plainly and finely shown, but it is difficult to fix it on paper, and it can only be done by allowing the

film to acquire great thickness, depositing it on unsized paper, and soaking the paper before drying, with gelatine.

*Preparation of Aluminum.*—M. Deville presented a new memoir on the preparation of aluminum; the only important novelty in which, appears to be the fact that the alcaline fluorides (such as fluor spar) appear to be the best fluxes for the metal. They are now making aluminum from kryolite, a double fluoride of aluminum and sodium, which occurs somewhat abundantly in Greenland.

*Water contained in Snow.*—Before the Academy of Sciences of St. Petersburg, M. Jeleznov related an experiment which he had made at Naronovo on the 3d and 4th of April, 1855, upon the height of the snow upon the ground and the quantity of water which it contained. The following are the results in inches and lines:—

| | Depth of Snow. | Depth of Water. | Ratio. Depth of Water. Depth of Snow. |
|---|---|---|---|
| 1 | 30· inches. | 96· lines. | 0·330 |
| 2 | 25·4 " | 78·8 " | 0·308 |
| 3 | 22·8 " | 60·6 " | 0·266 |
| 4 | 18·4 " | 45·5 " | 0·247 |
| 5 | 11·1 " | 21·9 " | 0·197 |
| 6 | 5·12 " | 8·9 " | 0·174 |
| Means. | 18·83 inches. | 51·87 lines. | 0·252 |

It will be seen by this table that the density of the snow doubled for the heights of snow varying from 1 to 6, and that as a mean, the density of the snow in this locality was one-quarter of the density of water.

An anomaly of some importance to be remarked, because it shows what erroneous results our rain-gauges may give, was established by these experiments. Thus it seems by the table, that the quantity of water given by the melted snow was 57·84 lines. Now, the quantity of water, according to the rain-gauges of the same locality, from 9th of December, 1854, to 4th of April, 1855, was only 34·71 lines, that is, less by 17·16 lines than that contained in the snow which covered the ground on 4th of April. How much greater would the difference be if we should take into account the quantity which evaporated and that which must have been absorbed by the ground? It was already known that the gauges gave only uncertain results, depending upon various causes, such as the force and direction of the wind, the hygrometric state of the air, the temperature, &c., but it will not be without use to place on record facts which give an idea of the great want of accuracy in such results.

*Helioplastic Engraving.*—M. Becquerel described at the meeting of 14th of January, the processes of engraving photographs invented by M. Poitevin, and called by him *Helioplastic Engraving*. It rests upon the property which gelatine has, when dried, impregnated with a chromate or bi-chromate and submitted to the action of light, of losing its property of swelling in water, whilst gelatine similarly prepared and not impressed, swells nearly six times its volume. A more or less thick layer of solution

of gelatine is laid on a plane surface, such as glass, suffered to dry, and then plunged into a solution of a bi-chromate, whose base has no direct action on the gelatine; it is again dried, and then influenced either through a photographic negative or a positive picture, or in the focus of a camera. After the impression, which must vary with the intensity of the light, the layer is plunged into water; then all the parts which have not received the influence of the light, swell and form reliefs, while those which have been affected absorb no water and remain as depressions. This surface is then transposed upon metal plates either by moulding in plaster or by the electrotype process.

The second process which M. Portevin employs for the purpose of applying, photographically, fatty matter upon paper, stone, or metallic surfaces by means of the action of light upon mixtures of chromates with gummy or mucilaginous matters, consists in applying one or more layers of this mixture upon the surfaces, and in impressing them, after drying, through the negatives of the pictures to be reproduced. Applying then, a fat ink by a tampon or roller, it will adhere only on the parts which have been acted on by the light. He has also applied colors either in powder or otherwise upon various surfaces uoon the same principles.

Several specimens were shown to the Academy.

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*On Working Steam Expansively in Marine Engines.* By Mr. E. Allen.*

(Continued from page 138.)

Table V. gives the total space occupied by the machinery and coals relatively to the entire hulls, and includes the averages of six vessels with side-lever engines, and six vessels with direct-acting engines, all belonging to the Peninsular and Oriental Steam Navigation Company; also the average of 1200 English merchant vessels.

From this Table it appears that from 34 to 44 per cent. of the *whole capacity* of the vessels is occupied by the engine-room and coals. The Table also gives the most general proportion of power to tonnage as one horse-power to every three tons.

[The author next gives in Tables VI. VII.,† the particulars of several steamers, with both screw and paddle-wheel engines, from which the comparative spaces occupied by the coals and machinery may be seen. From these Tables he deduces the following important particulars.]

1st. That in Government vessels the general proportion of coal taken is 1 ton per nominal horse-power, equal to about 1½ times the gross weight of machinery, as before given.

* From the Lond. Mechanics' Magazine, Aug., 1855.

† These and several other Tables, which occur afterwards, we are compelled to omit. We are, however, careful in all cases to give the results deduced from them, which will be sufficient for the objects of the paper.—Ed. M. M.

TABLE V.

| Average Registered Tonnage. | Average Tonnage of Engine-room. | Average Total Tonnage. | Average Horse-power. | Per centage of Engine-room to Total Tonnage. | Average total Tonnage per Horse-power. |
|---|---|---|---|---|---|
| Average of 6 Side-lever Engines, P. and O. S. N. Co. | | | | | |
| 1156 | 913 | 2069 | 636 | 44 per cent. | 3·25 |
| Average of 6 Direct-acting Engines, P. and O. S. N. Co. | | | | | |
| 1659 | 854 | 2513 | 794 | 34 per cent. | 3·16 |
| Average of 1200 English Merchant Steamers. | | | | | |
| 138 | 108 | 246 | 83 | 44 per cent. | 2·95 |

2d. That the horizontal space occupied by the entire engine-room, when this proportion of coal is taken, is about $4\frac{1}{2}$ square feet per nominal horse-power.

3d. That the space occupied by the coal bunkers carrying this proportion of fuel, may be taken at 2 or $2\frac{1}{4}$ square feet per horse-power, or about three times the space occupied by the engines alone, exclusive of boilers, passages, &c.

4th. That the space occupied by the engines alone, exclusive of boilers, coal bunkers, and passages, may be taken at $\frac{3}{4}$ square feet per nominal horse-power, that is, where the engines are direct-acting.

From an average of the eighteen estimates furnished to Government by different makers, and from some other cases, it appears that the space occupied by the boilers alone may be taken at about 1 square foot per nominal horse-power, and that the total price of £43 per horse-power for the machinery may be thus divided:—

| | £ | *s.* | *d.* | |
|---|---|---|---|---|
| Engines, boilers, and coal bunkers, | 38 | 0 | 0 | per horse-power. |
| Wheels, | 2 | 10 | 0 | " " |
| Spare gear, | 2 | 10 | 0 | " " |
| Total, | £43 | 0 | 0 | |

The amount for engines, &c., may be divided nearly as follows:—

| | £ | *s.* | *d.* | |
|---|---|---|---|---|
| Engines, | 24 | 0 | 0 | per horse-power. |
| Boilers, | 12 | 0 | 0 | " " |
| Coal bunkers, | 2 | 0 | 0 | " " |
| Total, | £38 | 0 | 0 | |

These proportions will be quite near enough for the purpose required, and the relation they bear to each other will not be much influenced by the present increased prices. It will therefore be assumed that the cost of the engines alone is about one-half the entire cost of machinery.

It will be requisite further to consider the average *annual expense* of

the coal used by steam vessels, and its proportion to the cost of the vessels or capital; this depending partly upon the class of vessel, and partly upon the service upon which she is engaged.

[In Table VIII., the author gives an approximation to the yearly cost of coal used by five classes of vessels, with the relation it bears to their cost.]

These comparisons will be found useful when the advantages of increasing the size of the engines are considered.

The cost of coal in London is taken at 16*s.* per ton.

The cost of coal in Liverpool is taken at 12*s.* per ton.

The cost of coal for Australian vessels at an average of 60*s.* per ton.

The cost of coal for Eastern Steam Navigation Company at 12*s.* per ton.

The price of coal is sometimes above these amounts, but they are near enough to illustrate the argument intended.

For better comparison, it will be desirable to condense the results, and this Table gives us the cost of engines alone (assumed at half the total cost of machinery) in

*Classes 3, 4, and 5, at 15 per cent. of the capital;
Class 2, . at 20 per cent. of the capital;
Class 1, . at 30 per cent. of the capital;

Also the yearly cost of coal in

Classes 2, 3, and 5, at say 5 per cent. of the capital;
Class 1, . at say 15 per cent. of the capital;
Class 4, . at say 25 per cent. of the capital;

In further illustration of this part of the subject, the subjoined accounts are added.

[In Table IX. is given by the West India Mail Steam Packet Company an account, showing the relative cost of coal, wages, &c., for 1850 and 1852, from which it appears that the cost of coals in 1850, was equal to 30 per cent. of the total working cost, and in 1852 equal to 35½ per cent.; and in Table X. is given the total actual expenses of coals, wages, &c., of the same Company for the year 1850, and the per centages of these items on the total cost of vessels.] This Table gives the cost of coals in 1850 equal to 28 per cent. of the working expenses, and nearly 13 per cent. of the total cost of vessels, and the whole working expenses at 45½ per cent. of the cost of vessels. If the mileage working expenses for 1850 be taken to amount to 45½ per cent. of the capital, then in 1852 the same expenses would be 53½ per cent., and from the respective ratios of the cost of coals to the total working expenses for those years, we have 13·74 per cent., and 19·02 per cent. as the cost of coals on the capital; consequently 15 per cent. may be fairly taken as a mean.

* These classes are as follows:—1. *River.* 2. *Continental.* 3. *American.* 4. *Australian.* 5. *Eastern Steam Navigation Company.*

For easy reference the following Table XI. is given:—

TABLE XI.

| When the Annual Cost of Coal on Capital amounts respectively to | 5 per cent. | 15 per cent. | 25 per cent. |
|---|---|---|---|
| Then 10 per cent. saving in Coal equals | ½ per cent. on capital. | 1½ per cent. on capital. | 2½ per cent. on capital. |
| " 20 " " " " | 1 " | 3 " | 5 " |
| " 30 " " " " | 1½ " | 4½ " | 7½ " |
| " 40 " " " " | 2 " | 6 " | 10 " |

As the least of these savings, in the middle column, frequently makes all the difference between a good and bad paying concern, it is quite certain that upon the expenses of the single item of coal may frequently hang the very existence of a Company.

It will be seen from the foregoing accounts, that there is little room for economizing the expenditure upon any other item, to anything like the extent possible in the item of coals alone, as the largest amount next that for coals, according to the mileage expenses, is for wages or repairs, each of these amounting to only about half the cost of the coals.

The following Tables XII., XIII., XIV., have been compiled in order to show the increased dividend on original capital which may be made by a saving in coal, owing to expansive working of the steam, the size or nominal horse-power of the engines being supposed to be increased from 1 to 1½, 2, 2½, and 3 times respectively, the extra cost of larger engines being proportionately allowed for, and the boilers and wheels or screw supposed to remain the same. The indicated or real horse-power is also supposed to remain the same, the larger engines being solely for the purpose of working the steam expansively. The first Table XII. is based on the supposition that the annual cost of coals is equal to 5 per cent. on the capital, and nearly agrees with the classes of vessels numbered 2, 3, and 5 in the Table VIII.

This proportionate cost of coals is here applied to cases in which the cost of the engine power (exclusive of boilers, wheels, or screw), is equal to 15 per cent. of the capital, say as in Classes 3 and 5, and also to cases in which the cost of the engine power is 20 per cent. of the capital, as in Class 2. Column A, gives the proportionate size or nominal horse-power of engines; column B, the proportionate quantity of coal required to develop an equal amount of power (in each case); column C, the proportionate cost of coal in per centage of capital; column D, the proportionate saving in cost of coal in per centage of capital, from which it appears that if the size of the engines be doubled, the saving is 1·45 per cent. on the capital, and if the size of the engines be increased to three times, the saving is 2·15 per cent. on the capital. From this saving on the item of coal, however, must be deducted the interest on the extra cost of larger engines, and this deduction will vary according to the proportionate expenses of the engines to the capital. Columns E, F, G, apply to the case in which the cost of the engines alone (exclusive of boilers, wheels, or screw) amounts to 15 per cent. of capital (as

in American vessels, and the Eastern Steam Navigation Company); and columns H, I, J, to the case in which the cost of engines alone amounts to 20 per cent. of capital, as in continental steamers, &c.; columns E and H give the necessary per centage of increase of capital; columns F and I the permanent charge on capital, being 5 per cent. allowed on the necessary addition made to it; and columns G and J, the gross gain in per centage of capital, after deducting the interest on extra cost of engines from the total gain or saving in coal. The results in this Table show that if the size of the engines be doubled, an additional 0·70 or 0·45 per cent. may be paid on capital, and that upon the engines being increased to three times the size, an additional 0·65 or 0·15 per cent. may be paid on capital, according as the cost of the engine power amounts to 15 per cent. or 20 per cent. of the capital respectively.

TABLE XII.

*Table showing the Increased Dividend on Capital, by a Saving in Coal from Expansive Working; the extra Cost of larger Engines being taken into account; Boilers, Wheels, or Screw, and Indicated Horse-Power being supposed to remain the same.*

| Proportional Nominal Horse-Power, or size of Engines. | Proportional cost of coal for same actual Power. | ANNUAL COST OF COALS TAKEN AT FIVE PER CENT. OF CAPITAL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cost of coal in per centage of original capital. | Saving in cost of coal in per centage of original capital. | Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 15 per cent. of Capital (say as in Classes 3 & 5). | | | Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 20 per cent. of capital (say as in Class 2). | | |
| | | | | Increas'g the Nominal horse-power, adds to Capital invested. | Permanent charge on Capital, being 5 per cent. on addit'n | Gross gain on Capital, deducting amounts in F from D. | Increasing the Nominal horse-power, adds to capital invested. | Permanent charge on capital, being 5 per cent. on addition. | Gross gain on capital, deducting amounts in I from D. |
| | | Per Cent. | Per Cent. | Per Cent | Per Cent | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| 1 | 1·00 | 5·00 | .. | .. | .. | .. | .. | .. | .. |
| 1½ | ·81 | 4·05 | ·95 | 7·50 | ·37 | ·57 | 10·00 | ·50 | ·45 |
| 2 | ·71 | 3·55 | 1·45 | 15·00 | ·75 | ·70 | 20·00 | 1·00 | ·45 |
| 2½ | ·63 | 3·15 | 1·85 | 22·50 | 1·12 | ·72 | 30·00 | 1·50 | ·35 |
| 3 | ·57 | 2·85 | 2·15 | 30·00 | 1·50 | ·65 | 40·00 | 2·00 | ·15 |
| A | B | C | D | E | F | G | H | I | J |

The second Table, XIII., is constructed in the same manner as the first, the annual cost of coals being taken at 15 per cent. of the capital, which, as before mentioned, applies to the class of vessels marked 1, and the West India Mail boats. This annual cost of coals is applied to the cases in which the cost of engines (exclusive of boilers, wheels, or screw), amounts to 20 per cent. of the capital, and also to the cases in which the cost of engines alone amounts to 30 per cent. of the capital; the general results are, that if the engines be increased to double the size, for the sake of expansive working, the saving of coal would be 4·35 per cent. of capital, and if the engines be increased to three times the size, the saving in coal would be 6·45 per cent. of capital. These amounts are reduced by the extra cost of engines respectively to 3·55 per cent. and 2·85 per cent. of capital, and to 4·45 per cent. and 3·45 per cent. of capital, according as the cost of engine power amounts to 20 per cent. or 30 per cent. of capital.

The third Table, XIV., is constructed in the same manner as the two former ones, the annual cost of coals being taken at 25 per cent. of the

capital, which, as shown before, applies to the Australian vessels, or class 4, where the cost of engines alone (exclusive of boilers, wheels, or screw), is equal to about 15 per cent. of capital. The results are, that if the size of the engines be doubled for expansive working, the saving of coal would amount to 7·25 per cent. of capital, and if increased to three times the size, the saving of coal would amount to 10·75 per cent. of capital. These amounts are reduced by the extra cost of engines to 6·50 per cent. and 9·25 per cent. of capital.

TABLE XIII.

*Table showing the Increased Dividend by a Saving in Coal from Expansive Working, the extra Cost of larger Engines being taken into account; Boilers, Wheels, or Screw, and Indicated Horse-Power being supposed to remain the same.*

| Proportional Nominal horse-power, or size of Engines. | Proportional cost of coal for same actual power. | ANNUAL COST OF COALS TAKEN AT FIFTEEN PER CENT. OF CAPITAL. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cost of coal in per centage of original capital. | Saving in cost of coal in per centage of original capital. | Cost of Engines alone (exclusive of Boilers, Screw, &c.) equals 20 per cent. of capital, (as in West India Mail Boats.) | | | Cost of Engines alone (exclusive of Boilers, Screw, &c.) equals 20 per cent. of capital, (as in River Boats, Class 1.) | | |
| | | | | Increasing the Nominal horse-power adds to capital invested. | Permanent charge on capital, being 5 per cent. on addition. | Gross gain on capital, deducting amounts in F from D | Increasing Nominal horse-power, adds to capital invested. | Permanent charge on capital, being 5 per cent. on addition. | Gross gain on capital, deduct'g amounts in I from D. |
| | | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| 1 | 1·00 | 15·00 | . . | . . | . . | . . | . . | . . | . . |
| 1½ | ·81 | 12·15 | 2·85 | 10 | ·50 | 2·35 | 15 | ·75 | 2·10 |
| 2 | ·71 | 10·65 | 4·35 | 20 | 1·00 | 3·35 | 30 | 1·50 | 2·85 |
| 2½ | ·63 | 9·45 | 5·55 | 30 | 1·50 | 4·05 | 45 | 2·25 | 3·30 |
| 3 | ·57 | 8·55 | 6·45 | 40 | 2·00 | 4·45 | 60 | 3·00 | 3·45 |
| A | B | C | D | E | F | G | H | I | J |

TABLE XIV.

*Table showing the Increased Dividend by a Saving in Coal from Expansive Working, the extra Cost of Larger Engines being taken into account; Boilers, Wheels, or Screw, and Indicated Horse-Power being supposed to remain the same.*

| Proportional nominal Horse-Power, or size of Engines. | Proportional cost of coal for same actual power. | ANNUAL COST OF COALS TAKEN AT 25 PER CENT. OF CAPITAL. | | | | |
|---|---|---|---|---|---|---|
| | | Cost of coal in per centage of original capital. | Saving in cost of coal in per centage of original capital. | Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 15 per cent of capital, (as in Australian Vessels, Class 4.) | | |
| | | | | Increasing the Nominal Horse-power, adds to capital invested. | Permanent charge on capital, being 5 per cent. on addition. | Gross gain on capital, deducting the amounts in F from D. |
| | | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| 1 | 1·00 | 25·00 | . . | . . | . . | . . |
| 1½ | ·81 | 20·25 | 4·75 | 7·50 | ·37 | 4·38 |
| 2 | ·71 | 17·75 | 7·25 | 15·00 | ·75 | 6·50 |
| 2½ | ·63 | 15·75 | 9·25 | 22·50 | 1·12 | 8·13 |
| 3 | ·57 | 14·25 | 10·75 | 30·00 | 1·50 | 9·25 |
| A | B | C | D | E | F | G |

It is evident that the dearer the coal is, or the larger the quantity consumed in proportion to the actual power developed, the more advantageous would be the saving effected by expansive working, as the per centage of saving in coal would the sooner cover any extra cost of engines; and the foregoing Tables clearly show that if the size of the engines be increased to *three* times for expansive working, and their *cost* be consequently *doubled*, there yet remains a gain, under the worst circumstances, of ·15 per cent. on capital, and under favorable circumstances, such as those presented by the Australian vessels, of 9¼ per cent. on capital.*

(To be continued.)

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## TWENTY-FIFTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.†

*On the Condition of the Atmosphere during Cholera.* By Dr. R. D. Thomson.—The chemical condition of cholera atmospheres is a question of intense interest in the subject of public health; but, with the exception of the unpublished experiments of Dr. Prout, in 1832, comparatively little attention appears to have been bestowed on it. One of the most striking circumstances connected with the occurrence of the disease is, that no change very palpable to the senses prevails, and even one may have remarked that the weather has usually been exceedingly agreeable. In London, at St. Thomas's Hospital, the neighborhood of which afforded a large supply of cholera cases, the relative weight of the air in August, 1854, a cholera month, and in August, 1855, when the metropolis was in an extremely healthy condition, is exhibited in the following table, in grains per cubic foot:—

| 1854. Week ending | Weight of Cubic F. in grains. | 1855. Week ending | Weight of Cubic Ft. in grains. |
|---|---|---|---|
| August 5 .. | 522·9 grains | August 4 .. | 516·9 grains |
| " 12 .. | 526·7 " | " 11 .. | 524·3 " |
| " 19 .. | 595·0 " | " 18 .. | 525·9 " |
| " 26 .. | 523·5 " | " 25 .. | 519·2 " |
| Sept. 2 .. | 525·1 " | Sept. 1 .. | 523·0 " |
| " 9 .. | 530·3 " | " 8 .. | 531·6 " |
| Mean .. | 525·6 " | Mean .. | 523·5 " |

The result, as deduced from this table, which has been calculated approximately from the barometric pressure and dry and wet bulb thermometer, is analogous to that obtained by Dr. Prout, in 1832, as the author was informed by himself. Corresponding observations have been made at Greenwich by Mr. Glaisher, and the same conclusions arrived at; from which it would appear that this superior weight of a given bulk

* It has not been considered necessary to include more than the five classes of vessels in the foregoing Tables, although many other classes exist, in which the proportionate cost of coal and machinery vary from the amounts given. In order, however, to ascertain what advantages would be gained by the substitution of larger engines in any specific case, it will only be necessary to substitute the correct amounts in place of those given above.

† From the Lond. Athenæum, September, 1855.

of air was not a local phenomenon, but was diffused to considerable distances, and the character distinguishing September, 1854, from the corresponding period in 1855, was the absence of any atmospheric action on ozone test-paper in the former season, while during the present year the oxidizing influence of the air has never been absent at St. Thomas's Hospital. During September, 1854, however, when no ozone could be detected in London, its action was sometimes faintly and often very strongly marked at Lewisham, near Greenwich. Throughout the same periods the air was exceedingly stagnant: and it has since been observed by Mr. Glaisher, and also at Vienna, that rapid atmospheric movement is pretty constantly accompanied by an oxidizing condition of the air. With reference to the chemical composition in the atmosphere of inhabited localities and of malarious districts, experiments have usually been conducted on the constitution of the gases which enter into the composition of the air. But the results seem to have thrown little light on the possibility of the production, from such causes, of any disease characterized by a regular sequence of symptoms. So far as our knowledge warrants, gases can either act only as asphyxiating media by the exclusion of oxygen, or as slow or rapid poisons. The cause capable of inducing a disease formed on a peculiar type, analogy leads us to infer must be an organized condition, either in a solid form or in a finely diffused or vaporific state. The fact observed, that in malarious atmospheres sulphuric acid speedily becomes black, also points to the propriety of examining the air in such situations with the view of filtering from it solid or condensible matter. In the epidemic of 1849-50, the author examined the exterior air of an infected district with this object in view to the extent of many cubic feet, but the result was comparatively negative, and led to the inference that the examination of large masses of air could alone hold out any prospect of a successful issue. For this purpose air was passed through carefully prepared distilled water contained in Woulfe's bottles by means of a large aspiratory apparatus of the capacity of 16 cubic feet, which was kept constantly in action during the day for several months. Occasionally, freezing mixtures were applied to portions of the apparatus, and a tube filled with pumice moistened with sulphuric acid placed next the aspirator completed the series. A range of tubes conducted the air from a cholera ward into the aspirator. The ward was 32 feet long, 20 feet wide, and 9 feet high. The air was drawn from the centre of the ward near the ceiling; and when the apartment was filled with cholera patients, the air, after traversing several layers of distilled water, was speedily cleared by the sulphuric acid, and deposited a variety of solids in all the Woulfe's bottles, which could even be detected in some measure by the eye. The objects consisted of blue and red cotton fibres from the dresses of the inmates, portions of hair, wool, fungi, sporules of fungi, abundance of vibriones or lower forms of animal life, with particles of silica and dirt. In this and all the experiments conducted on the air of closed apartments, the distilled water was rendered strongly acid from the presence of sulphuric and sulphurous acids derived from the products of gas and coal combustion. The distilled water employed in these experiments was boiled for some time previous to being introduced into the apparatus, and was divided

into two portions; one part being placed in a stopped bottle beside the Woulfe's bottles through which the air was conducted, the sediment, if any, being afterwards examined and compared with that resulting from the experiment. When the ward was partially full, vegetable epiderm, vegetable cellular tissue, fragments of wool, cotton, linen, vegetable hairs, a sponge spicula, minute fungi, spiral vessels, sporules, spore cases, animal epithelium, oil globules, and silicious particles were detected,—while vibriones were entirely absent, or at least mere traces could be discriminated. This is an interesting result, since in the first case only 98·6 cubic feet were examined, and of the partially empty ward, 240 cubic feet passed through the apparatus. When the ward was empty, cotton fibres, wool, a trace of fungus with carbonaceous and silicious particles were alone discernible,—the amount of air examined being 304 cubic feet. The air external to the ward and in the immediate neighborhood afforded from 560 cubic feet one cotton fibre, one of wool, a crystalline body—probably a sponge spicula, sporules, beautiful mycelia of fungi in various stages of development, and some carbonaceous matter. The distilled water in this instance likewise yielded a strongly acid reaction, produced by sulphur acids. The possible influence of sewer atmospheres predicated interesting results from an examination of such air,—and accordingly it was found that the predominating feature of this experiment, was animal life in the form of swarms of vibriones in various stages of advancement. The chemical re-action in this case, unlike that in the preceding experiments, was invariably alkaline, due to the evolution of ammonia from the nitrogenous matters contained in the sewage liquors. These experiments render it sufficiently obvious that organic living bodies constantly surround us in close apartments, and particularly that animal matter under certain circumstances is likewise diffused through such atmospheres. They fail to point out any matter capable of communicating choler afrom one individual to another through the medium of the air, and therefore are so far important to the public; but they show that foreign animal matter injurious to health may speedily be concentrated in certain localities, which will undoubtedly assist in the production and propagation of disease in conjunction with meteorological conditions. Pathological investigations carefully conducted by the author's colleague, Mr. Rainey, detected in one case an entozoon in the glottis or upper part of the air-passage, the only analogue of which has been found in the substance of the muscle of animals, which would seem to indicate that the germ of this creature had been derived from the atmosphere, or at least from external sources. It is intended that these experiments, which are tedious and laborious in their character, shall be extended to other atmospheres, so as to obtain comparative series of views, so to speak, of air modified by the influence of different diseases.

*On Papyrus Bonapartea, and other Plants which can furnish Fibre for Paper Pulp.* By Chevalier De Claussen.—The paper makers are in want of a material to replace rags in the manufacture of paper, and I have therefore turned my attention to this subject, the result of which I will communicate to the Association. To make this matter more comprehensible I will explain what the paper-makers want. They require a cheap material, with a strong fibre, easily bleached, and of which an

unlimited supply may be obtained. I will now enumerate a few of the different substances which I have examined for the purpose of discovering a proper substitute for rags. Rags containing about 50 per cent. of vegetable fibre mixed with wool or silk are regarded by the paper-makers as useless to them, and several thousand tons are yearly burned in the manufacture of prussiate of potash. By a simple process which consists in boiling these rags in caustic alkali, the animal fibre is dissolved, and the vegetable fibre is available for the manufacture of white paper pulp. Surat, or Jute, the inner bark of *Corchorus indicus*, produces a paper pulp of inferior quality bleached with difficulty. Agave, *Phormium tenax*, and Banana or plantain fibre (Manilla hemp), are not only expensive, but it is nearly impossible to bleach them. The banana leaves contain forty per cent. of fibre. Flax would be suitable to replace rags in paper manufacture, but the high price and scarcity of it, caused partly by the war, and partly by the injudicious way in which it is cultivated, prevents that. Six tons of flax straw are required to produce one ton of flax fibre, and by the present mode of treatment all the woody part is lost. By my process the bulk of the flax straw is lessened by partial cleaning before retting, whereby about 50 to 60 per cent. of shoves (a most valuable cattle food) are saved, and the cost of the fibre reduced. By the foregoing it will be seen that the flax plant only produces from 12 to 15 per cent. of paper pulp. All that I have said about flax is applicable to hemp, which produces 25 per cent. of paper pulp. Nettles produce 25 per cent. of a very beautiful and easily bleached fibre. Palm-leaves contain 30 to 40 per cent. fibre, but are not easily bleached. The Bromeliaceæ contain from 25 to 40 per cent. fibre. *Bonapartea juncoidea* contains 35 per cent. of the most beautiful vegetable fibre known; it could not only be used for paper pulp, but for all kinds of manufactures in which flax, cotton, silk, or wool are employed. It appears that this plant exists in large quantities in Australia, and it is most desirable that some of our large manufacturers should import a quantity of it. The plant wants no other preparation than cutting, drying, and compressing like hay. The bleaching and finishing may be done here. Ferns give 20 to 25 per cent. fibre, not easily bleached. Equisetum from 15 to 20 per cent. inferior fibre, easily bleached. The inner bark of the lime-tree (Tilia) gives a fibre easily bleached, but not very strong. Althea and many Malvacæ produce from 15 to 20 per cent. paper pulp. Stalks of beans, peas, hops, buckwheat, potatoes, heather, broom, and many other plants contain from 10 to 20 per cent. of fibre,—but their extraction and bleaching present difficulties which will probably prevent their use. The straws of the Cereals cannot be converted into white paper pulp after they have ripened the grain; the joints or knots in the stalks are then so hardened that they will resist all bleaching agents. To produce paper pulp from them they must be cut green before the grain appears, and this would probably not be advantageous. Many grasses contain from 30 to 50 per cent. of fibre, not very strong, but easily bleached. Of indigenous grasses, the Rye grass contains 35 per cent. of paper pulp; the Phalaris 30 per cent.; Arrenatherum 30 per cent.; Dactylis 30 per cent.; and Carex 30 per cent. Several reeds and canes contain from 30 to 50 per cent. of fibre, easily bleached. The stalk of the sugar-cane gives

40 per cent. of white paper pulp. The wood of the Coniferea gives a fibre suitable for paper pulp. I made this discovery accidentally in 1851, when I was making flax cotton in my model establishment at Stepney, near London. I remarked that the pine wood vats in which I bleached were rapidly decomposed on the surface into a kind of paper pulp; I collected some of it, and exhibited in the Great Exhibition,—but as at that time there was no want of paper material no attention was paid to it. The leaves and top branches of Scotch fir produce 25 per cent. of paper pulp. The shavings and sawdust of wood from Scotch fir gives 40 per cent. pulp. The cost of reducing to pulp and bleaching pine wood, will be about three times that of bleaching rags. As none of the above named substances or plants, would entirely satisfy on all points the wants of the paper-makers, I continued my researches, and at last remembered the papyrus (the plant of which the ancients made their paper), which I examined, and found to contain about 40 per cent. of strong fibre, excellent for paper, and very easily bleached. The only point which was not entirely satisfactory was relative to the abundant supply of it, as this plant is only found in Egypt. I directed, therefore, my attention to plants growing in this country; and I found to my great satisfaction that the common rushes (*Juncus effusus* and others) contain 40 per cent. of fibre, quite equal, if not superior, to the papyrus fibre, and a perfect substitute for rags in the manufacture of paper, and that one ton of rushes contains more fibre than two tons of flax straw.

*On the Hancornia speciosa, Artificial Gutta Percha and India Rubber.*—By the Chevaliar De Claussen.—In the course of my travels as botanist in South America, I had occasion to examine the different trees which produce the india rubber, and of which the *Hancornia speciosa* is one. It grows on the high plateaux of South America, between the tenth and twentieth degrees of latitude south, at a height from three to five thousand feet above the level of the sea. It is of the family of the Sapotaceæ, the same to which belongs the tree which produces gutta percha. It bears a fruit, in form not unlike a bergamot pear, and full of a milky juice, which is liquid india rubber. To be eatable this fruit must be kept two or three weeks after being gathered, in which time all the india rubber disappears or is converted into sugar, and is then in taste one of the most delicious fruits known, and regarded by the Brazilians (who call it Mangava) as superior to all other fruits of their country. The change of india rubber into sugar, led me to suppose that gutta percha, india rubber, and similar compounds contained starch. I have therefore tried to mix it with resinous or oily substances, in combination with tannin, and have succeeded in making compounds which can be mixed in all proportions with gutta percha or india rubber without altering their characters. By the foregoing it will be understood that a great number of compounds of the gutta percha and india rubber class may be formed by mixing starch, gluten, or flour with tannin and resinous or oily substances. By mixing some of these compounds with gutta percha or india rubber, I can so increase its hardness that it will be like horn, and may be used as shields to protect the soldiers from the effect of the Minie balls, and I have also no doubt that some of these compounds in combination with iron, may be useful in floating batteries, and many other purposes, such

as the covering the electric telegraph wires, imitation of wood, ship-building, &c.

*On the Employment of Algæ, and other Plants in the Manufacture of Soaps.* By the Chevalier De Claussen.—When I was experimenting on several plants for the purpose of discovering fibres for paper pulp, I accidentally treated some common sea-weeds with alkalies, and found they were entirely dissolved, and formed a soapy compound which could be employed in the manufacture of soap. The making of soaps directly from sea-weeds must be more advantageous than burning them for the purpose of making kelp, because the fucusoid and glutinous matter they contain are saved and converted into soap. The Brazilians use a malvaceous plant (Sida) for washing instead of soap, and the Chinese use flour of beans in the scouring of their silk; and I have found that not alone sea-weed, but also many other glutinous plants, and gluten, may be used in the manufacture of soap with advantage.

The Section resumed discussion of the subject of "*Artillery and Projectiles*," when

Dr. Scoresby stated, as the result of experiments he had made, that the quality of iron might be effectually tested by its effect in counteracting the deviation produced on a compass by a magnet placed in opposition to it.—Mr. Neilson, iron-founder, gave, as the result of his experience, that, if repeatedly heated, or heated without being subjected to severe hammering or pressure, the centre of a mass of iron was sure to become crystalline and friable.—Mr. Rennie thought the defects of the artillery of the present day were, in a great degree, to be attributed to the competition in cheapness among manufacturers.—Mr. Western suggested the appointment of a committee to collect information on the subject from practical men.—The Duke of Argyll expressed the obligation the Government would be under to such a committee for the information it might collect.—Sir E. Belcher stated that, in engagements which he had witnessed, much more severe than that of Sweaborg, no accidents whatever had occurred to the ordnance. He suggested the employment of guns similar to those of the Chinese, with strong cast iron breeches, the direction tube being a matter of little moment.

*On the Effects of Screw Propellers when moved at different Velocities and Depths.* By Mr. G. Rennie.—From experiments which had been made under his observation, it was desirable that the screws of vessels should be of small dimensions, light, and of rapid motion, and that their effect would be increased by their being as deeply immersed as possible. He also recommended the disk screw.

Several Members questioned the effect attributed in the paper, to deep immersion.

*On a Momentum Engine for Steam or Water.* By Mr. W. Gorman.—The principle of which was the direction of a strong jet of steam into the buckets of a wheel, which were to be so constructed and placed as to render every particle of the force of the jet serviceable. The engine seemed to be suitable for cases where rapid motion was necessary without great force.

*On the Relation between Revolving Storms and Explosions in Coal Mines.* By Mr. T. Dobson.—Many observations were made in several

parts of Great Britain, which seemed to establish an intimate relation between revolving storms and barometric changes; and that explosions were most frequent when the barometer is falling and the wind southerly, while they never occurred when the barometer stood high, and at the same time the wind north. The paper was illustrated by a carefully executed storm map.

Dr. Robinson suggested the appointment of an inspector of mines with respect to the state of the gases, temperature, &c., so that proper precautions might be used to prevent accidents. This, he thought, would be the only practical benefit to be derived from the experiments of Mr. Dobson.

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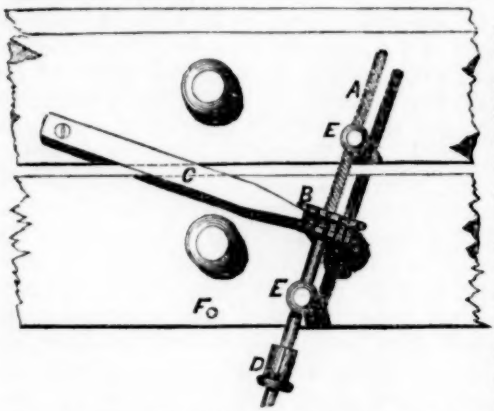
*A New Parallel and Radial Rule.* By E. T. Loseby.*

The accompanying engraving represents the middle of the rule, containing the improved portions; the ends being of the ordinary construction, they are omitted.




A is a straight steel wire, made into a screw at one end, on which is fixed a nut, B, milled on the edges and divided into ten notched divisions, which admit the end of the steel spring, C, and prevent the screw being accidentally moved; the spring is made to travel with the screw, by its acting in a groove sunk in the nut; D, a clamp, milled on the edge, which is slit to make it move tightly and evenly along the wire; the audible sound which the spring makes in falling into the notches enables them to be counted by ear to relieve the eye; whole turns are counted by a mark placed on the nut, and every tenth turn by a notch in the wire. E E, two studs, screwed into the rule, in one of which the screw works and the other forms a stop, which, limiting the range of the clamp, D, regulates the distance the rule opens; the holes in the studs are a little elongated horizontally, to allow of the wire accommodating itself to the motion of the rule; the wire being placed at the best angle with the joint arms for reducing the motion to the lowest amount.

The screw should be of the proper pitch to open the rule $\frac{1}{100}$ of an inch each revolution, which it would do with 100 turns to the inch if placed at a right angle with the rule, but as the proper angle is rather less, the screw requires to be proportionably coarser, in order that each division on the nut may be equal to $\frac{1}{1000}$ of an inch, each turn to $\frac{1}{100}$, and each notch on the wire to $\frac{1}{10}$.

* From the Lond. Journ. of the Society of Arts., No. 155.

In setting the rule to open accurately a particular distance, the nut, B, is screwed forward close to the screw-stud, and the clamp, D, pressed along the wire to the stop-stud, so as to keep the rule quite close without it being strained. The marked division on the nut should now be uppermost, and the clamp at the zero notch on the wire; the nut is then unscrewed the requisite number of turns and parts of a turn, to accord with the number of tenths, hundredths, and thousandths of an inch required. For less accurate purposes, the clamp may be set to the proper division on the wire by the eye, without it being screwed home, the object of which is to ensure perfect contact of the bearings.

The rule is converted from a parallel to a radial rule by a point placed at F, and a small hole, not shown in the drawing, drilled in the line of the straight-edge at the end towards the left hand, through which, and the centre of the circle to be divided, a pin is driven into the drawing-board; the rule being then opened and closed in the ordinary way by a finger placed on each of the studs, it is constrained by the points to move round in a circle.

One of the finger-studs is made to serve for the point by screwing it into the hole, F, and the rule being thinner towards the edge, it allows the point to project sufficiently there without projecting when placed in the other hole for drawing parallel lines; the studs are milled on the edge to facilitate their being unscrewed with the fingers.

The different parts should be so proportioned and arranged that when the back point is placed at F, so as to be convenient for the fingers, the two points will remain at the same distance from each other, and simply revolve whilst the rule is being opened and closed, and that ten turns of the screw will be equal to 1°. Both these conditions can be fulfilled if the proper size and position of the following parts are observed, viz:—the distance between the two points, and the distance of F from the straight-edge; the length of the joint-arms from centre to centre, and the angle they are placed at on the rule.

Amongst the uses of the rule the following may be mentioned:—

For drawing any number of lines at equal distances—as, for example, those in sectional drawing, shading, flights of steps, screw threads, laying on a tint of equal lines similar to engravers' machine-ruling, ruling paper for tables, writing, &c.

For drawing lines at increasing or diminishing distances—as, for instance, giving the position, without individual measurement, of doors, windows, columns, &c., in a range of buildings seen in perspective; the position of wheel-teeth seen edgeways, &c.

For graduating straight scales of divisions either at equal distances, as those of thermometers, &c., or at accumulating distances, as those of hydrometers.

For drawing radial lines round a circle, either at equal distances or at increasing or diminishing distances.

For dividing circular scales into equal or accumulating spaces, laying down angles, &c.

A gauge for short distances, giving micrometer measurements.

It would add to the security of the rule in drawing parallel lines if four pointed screws, similar to the one used at F, were placed at the

corners to diminish the risk of its slipping; but for very accurate work, such as engravers', this may be more effectually done by fixing the back of the rule to the drawing-table frame, or board with pins, reversing the clamp, D, and placing it to act on the other side of the stop-stud, and working the front half of the rule by the screw alone. This arrangement will allow a tool to be pressed against the straight-edge with sufficient force for engraving wood blocks or steel plates.

One or two other things remain to be noticed which apply to ordinary rules as well as to those above described. First, they should have disks of thin metal between the joint arms and the rule, to prevent any rubbing at a distance from the rivets. Secondly, the straight-edge should be of steel, hardened and tempered to resist the action of tools drawn along it; the steel, which is cheaply prepared for ladies' stays, answers very well; it may be fixed by being cemented into a groove in the rule. Thirdly, the rule, instead of being flat on the under side, as they are usually made, should be slightly bevelled towards both edges, so as to divide the width into three equal bearings; this effects two objects, one of which is to make the rule easier to work and less liable to shift accidentally, as when one side is pressed down it raises the other, and keeps it quite free whilst it is being moved; the other object is to enable the same straight-edge to be raised different distances from the paper whilst drawing the lines by pressing down the front, middle, or back of the rule.

As several years have elapsed since the construction was completed and arranged in the present form, after several others that occurred to me had been tried, and as improvements in mathematical instruments very seldom repay the heavy cost of a patent, the construction is now open for any one to manufacture; but in order to afford further facility for its being properly carried out, I have furnished detailed instructions to the principal mathematical instrument makers, who are making arrangements for supplying the improved rules to the public; having done thus much in the matter and occupied several months with the rule at different times, it must rest with them whether it is perfectly manufactured or not.

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### *Magnetic Gauge for Steam Boilers.**

This is said to be the first application of magnetism to steam-boilers. The apparatus consists of a metallic hollow spheriod suspended by an iron rod, the end of which is a bar of steel strongly magnetised. This magnet rises and falls in a brass box, which serves as a sort of cage to enclose it. Upon the face of this box, which is graduated in centimetres or inches, moves a small needle or pointer, separated from all mechanical support, but attracted only through the loop of the magnet, all of whose motions it follows. The extreme limits of the floating ball can only be reached by touching the stops which open the alarm-whistle, so that a failure or an over-supply of water is immediately detected. The graduated surface of the gauge is silvered, so that the continual motion of the pointer is readily seen at any distance.

* From the London Artizan, February, 1856.

The apparatus is protected by a glass cover, which preserves the needle from injury and keeps the graduated scale constantly clean.

The price of the gauge, without the valve, is from 170 to 180 francs, and the gauge and whistle from 30 to 90 francs extra.

This gauge is merely a bad copy of Faber's Magnetic Gauge, patented in this country, and described in this *Journal*, (present Series,) Vol. xxi, p. 215. The Faber Gauge is very superior to the one exhibited at the French Exhibition, which has been altered merely to disguise the theft, and has no novelty but its defects. EDITOR.

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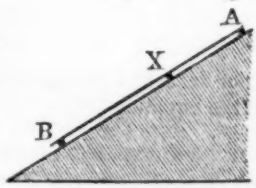
*On the Descent of Glaciers.* By the Rev. HENRY MOSELEY, M.A, F.R.S.*

If we conceive two bodies of the same form and dimensions (cubes for instance,) and of the same material, to be placed upon a uniform horizontal plane, and connected by a substance which alternately extends and contracts itself, as does a metallic rod when subjected to variations of temperature, it is evident that by the extension of the intervening rod, each will be made to recede from the other by the same distance, and, by its contraction, to approach it by the same distance. But if they be placed on an inclined plane (one being lower than the other), then when by the increased temperature of the rod its tendency to extend becomes sufficient to push the lower of the two bodies downwards, it will not have become sufficient to push the higher upwards. The effect of its extension will therefore be to cause the lower of the two bodies to descend whilst the higher remains at rest. The converse of this will result from contraction; for when the contractile force becomes sufficient to pull the upper body down the plane it will not have become sufficient to pull the lower up it. Thus, in the contraction of the substance which intervenes between the two bodies, the lower will remain at rest whilst the upper descends. As often, then, as the expansion and contraction is repeated the two bodies will descend the plane until, step by step, they reach the bottom.

Suppose the uniform bar AB placed on an inclined plane, and subject to extension from increase of temperature, a portion XB will descend, and the rest XA will ascend; the point X where they separate being determined by the condition that the force requisite to push XA up the plane is equal to that required to push XB down it.

Fig. 1.




Let AX=$x$, AB=L, weight of each linear unit=$u$, $i$=inclination of plane, $\phi$=limiting angle of resistance,

$$\therefore \quad ux = \text{weight of AX},$$
$$u(L-x) = \text{weight of BX}.$$

Now, the force acting parallel to an inclined plane which is necessary to push a weight w up it, is represented by

$$w\frac{\sin(\phi + i)}{\cos\phi};$$

* From the Lond., Edin., and Dub. Philos. Mag., July, 1855.

corners to diminish the risk of its slipping; but for very accurate work, such as engravers', this may be more effectually done by fixing the back of the rule to the drawing-table frame, or board with pins, reversing the clamp, D, and placing it to act on the other side of the stop-stud, and working the front half of the rule by the screw alone. This arrangement will allow a tool to be pressed against the straight-edge with sufficient force for engraving wood blocks or steel plates.

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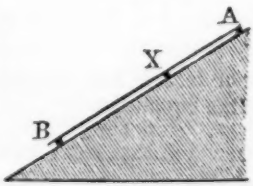
*On the Descent of Glaciers.* By the Rev. HENRY MOSELEY, M.A, F.R.S.*

If we conceive two bodies of the same form and dimensions (cubes for instance,) and of the same material, to be placed upon a uniform horizontal plane, and connected by a substance which alternately extends and contracts itself, as does a metallic rod when subjected to variations of temperature, it is evident that by the extension of the intervening rod, each will be made to recede from the other by the same distance, and, by its contraction, to approach it by the same distance. But if they be placed on an inclined plane (one being lower than the other), then when by the increased temperature of the rod its tendency to extend becomes sufficient to push the lower of the two bodies downwards, it will not have become sufficient to push the higher upwards. The effect of its extension will therefore be to cause the lower of the two bodies to descend whilst the higher remains at rest. The converse of this will result from contraction; for when the contractile force becomes sufficient to pull the upper body down the plane it will not have become sufficient to pull the lower up it. Thus, in the contraction of the substance which intervenes between the two bodies, the lower will remain at rest whilst the upper descends. As often, then, as the expansion and contraction is repeated the two bodies will descend the plane until, step by step, they reach the bottom.

Suppose the uniform bar AB placed on an inclined plane, and subject to extension from increase of temperature, a portion XB will descend, and the rest XA will ascend; the point X where they separate being determined by the condition that the force requisite to push XA up the plane is equal to that required to push XB down it.

Fig. 1.




Let AX=$x$, AB=L, weight of each linear unit=$u$, $i$=inclination of plane, $\phi$=limiting angle of resistance,

$$\therefore \quad ux = \text{weight of AX},$$
$$u(L-x) = \text{weight of BX}.$$

Now, the force acting parallel to an inclined plane which is necessary to push a weight w up it, is represented by

$$w\frac{\sin(\phi+i)}{\cos\phi};$$

* From the Lond., Edin., and Dub. Philos. Mag., July, 1855.

and that necessary to push it down the plane by

$$w\frac{\sin(\phi-i)}{\cos\phi};$$

$$\therefore\quad ux\frac{\sin(\phi+i)}{\cos\phi}=u(L-ux)\frac{\sin(\phi-i)}{\cos\phi}$$

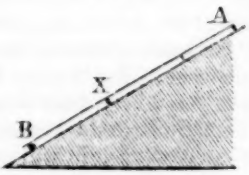
$$\therefore\quad x\{\sin(\phi+i)+\sin(\phi-i)\}=L\sin(\phi-i)$$

$$\therefore\quad x\sin\phi\cos i=L\sin(\phi-i)$$

$$\therefore\quad x=\frac{1}{2}L\frac{\sin(\phi-i)}{\sin\phi\cos i}$$

$$\therefore\quad x=\frac{1}{2}L\left\{1-\frac{\tan i}{\tan\phi}\right\}.$$

Fig. 2.




When contraction takes place the converse of the above will be true. The separating point X will be such, that the force requisite to pull XB up the plane is equal to that required to pull AX down it. BX is obviously in this case equal to AX in the other.

Let $\lambda$ be the elongation per linear unit under any variation of temperature; then the distance which the point B (see fig. 1) will be made to descend by this elongation.

$$=\lambda\,.\overline{BX}$$
$$=\lambda(L-x)$$
$$=\frac{1}{2}\lambda L\left(1+\frac{\tan i}{\tan\phi}\right).$$

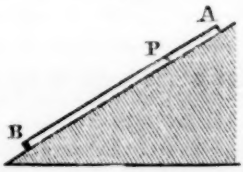
If we conceive the bar now to return to its former temperature, contracting by the same amount ($\lambda$) per linear unit; then the point B (fig. 2) will by this contraction be made to ascend through the space

$$BX.\,\lambda=x\lambda$$
$$=\frac{1}{2}L\lambda\left\{1-\frac{\tan i}{\tan\phi}\right\}\quad\ldots\ldots\ldots\quad(1)$$

Total descent $l$ of B by elongation and contraction is therefore determined by the equation

$$l=L\lambda\frac{\tan i}{\tan\phi}\quad\ldots\ldots\ldots\ldots\quad(2)$$

Fig. 3.




To determine the pressure upon a nail, driven through the rod at any point P fastening it to the plane.

It is evident that in the act of extension the part BP of the rod will descend the plane and the part AP ascend; and conversely in the act of contraction; and that in the former case the nail B will sustain a pressure upwards equal to that necessary to cause BP to descend, and a pressure downwards equal to that necessary to cause PA to ascend; so

that, assuming the pressure to be downwards, and adopting the same notation as before, except that AP is represented by $\rho$, AB by $a$, and the pressure upon the nail (assumed to be downwards) by P, we have in the case of extension

$$P = u\rho\frac{\sin(\phi+i)}{\cos\phi} - u(a-\rho)\frac{\sin(\phi-i)}{\cos\phi},$$

and in case of contraction

$$P = u(a-\rho)\frac{\sin(\phi+i)}{\cos\phi} - u\rho\frac{\sin(\phi-i)}{\cos\phi}.$$

Reducing, these formulæ become respectively

$$P = \frac{u}{\cos\phi}\left\{2\rho\sin\phi\cos i - a\sin(\phi-i)\right\} \quad . \quad . \quad . \quad (3)$$

$$P = \frac{u}{\cos\phi}\left\{a\sin(\phi+i) - 2\rho\sin\phi\cos i\right\} \quad . \quad . \quad . \quad (4)$$

My attention was first drawn to the influence of variations in temperature to cause the descent of a lamina of metal resting on an inclined plane, by observing, in the autumn of 1853, that a portion of the lead which covers the south side of the choir of the Bristol Cathedral, which had been renewed in the year 1851, but had not been properly fastened to the ridge beam, had descended bodily 18 inches into the gutter; so that if plates of lead had not been inserted at the top, a strip of the roof of that length would have been left exposed to the weather. The sheet of lead which had so descended measured, from the ridge to the gutter, 19 feet 4 inches and along the ridge 60 feet. The descent had been continually going on, from the time the lead had been laid down. An attempt made to stop it by driving nails through it into the rafters had failed. The force by which the lead had been made to descend, whatever it was, had been found sufficient to draw the nails.* As the pitch of the roof was only $16\frac{1}{2}°$, it was sufficiently evident that the weight of the lead alone could not have caused it to descend. Sheet lead, whose surface is in the state of that used in roofing, will stand firmly upon a surface of planed deal when inclined at an angle of 30°,† if no other force than its weight tends to cause it to descend. The considerations which I have stated in the preceding articles led me to the conclusion that the daily variations in the temperature of the lead, exposed as it was to the action of the sun by its southern aspect, could not but cause it to descend considerably, and the only question which remained on my mind was, whether this descent could be so great as was observed. To determine this I took the following data:—

* The evil was remedied by placing a beam across the rafters near the ridge, and doubling the sheets round it, and fixing their ends with spike nails.

† This may easily be verified. I give it as the result of a rough experiment of my own. I am not acquainted with any experiments on the friction of lead made with sufficient care to be received as authority in this matter. The friction of copper on oak has, however, been determined by General Morin to be 0·62, and its limiting angle of resistance 31° 48′; so that if the roof of Bristol Cathedral had been inclined at 31° instead of 16°, and had been covered with sheets of cepper resting on oak boards, instead of sheets of lead resting on deal, the sheeting would not have slipped by its weight only.

Mean daily variation of temperature at Bristol in the month of August, assumed to be the same as at Leith (Kaemtz, Meteorology, by Walker, p. 18,) 8°·21 Cent.

Linear expansion of lead through 100° Cent. ·0028436.

Length of sheets of lead forming the roof from the ridge to the gutter 232 inches.

Inclination of roof 16° 32′.

Limiting angle of resistance between sheet lead and deal 30°.

Whence the mean daily descent of the lead, in inches, in the month of August, is determined by equation (2) to be

$$l = 232 \times \frac{8°\cdot21}{100} \times \cdot0028436 \times \frac{\tan 16° 32'}{\tan 30°}$$

$$l = \cdot027848 \text{ inches.}$$

The average daily descent gives for the whole month of August a descent of ·863288. If the average daily variation of temperature of the month of August had continued throughout the year, the lead would have descended 10·19148 inches every year. And in the two years from 1851 to 1853 it would have descended 20·38296 inches. But the daily variations of atmospheric temperature are less in the other months of the year than in the month of August. For this reason, therefore, the calculation is in excess. For the following reasons it is in defect:—1st, the daily variations in the temperature of the lead cannot but have been greater than those of the surrounding atmosphere. It must have been heated above the surrounding atmosphere by radiation from the sun in the day-time, and cooled below it by radiation into space at night. 2dly, One variation of temperature only has been assumed to take place every twenty-four hours, viz: that from the extreme heat of the day to the extreme cold of the night; whereas such variations are notoriously of constant occurrence during the twenty-four hours. Each cannot but have caused a corresponding descent of the lead, and their aggregate result cannot but have been greater than if the temperature had passed uniformly (without oscillations backwards and forwards) from one extreme to the other.

These considerations show, I think, that the causes I have assigned are sufficient to account for the fact observed. They suggest, moreover, the possibility that results of importance in meteorology may be obtained from observing with accuracy the descent of a metallic rod thus placed upon an inclined plane. That descent would be a measure of the aggregate of the changes of temperature to which the metal was subjected during the time of observation. As every such change of temperature is associated with a corresponding development of mechanical action under the form of work,* it would be a measure of the aggregate of such changes and of the work so developed during that period; and relations might be found between measurements so taken in different equal periods of times, successive years for instance, tending to the development of new meteorological laws.†

* Mr. Joule has shown (Phil. Trans. 1850, Part I.) that the quantity of heat capable of raising a pound of water by 1° Fahr. requires for its evolution 772 units of work.

† The remainder of this paper, in which these principles are applied to the explanation of glacier motion, is founded on a misconception and is fallacious. It has therefore been omitted. Editor.

# FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, February 21st, 1856.*

John C. Cresson, President, in the chair.
John Agnew, Vice President.
Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Royal Society and the Zoological Society, London, and from the Regents of the University of the State of New York.

Donations to the Library were received from the Royal Institution, the Zoological Society, the Institute of Actuaries, and the Society of Arts, &c., London; The Royal Irish Academy, Dublin; The Commissioner of Indian Affairs, Thomas U. Walter, Esq., and M. T. W. Chandler, Esq., Washington, D. C.; Captain Charles Wilkes, U. S. Navy; The Maryland Institute, Baltimore, Maryland; Prof. John F. Frazer, Prof. B. H. Rand, and H. Nolen, Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Standing Committees for the ensuing year were appointed by the President and approved as follows:

*On the Library.*

John Allen,
James H. Cresson,
George W. Conarroe,
George Erety,
Samuel B. Finch,
Raper Hoskins,
James Lukens,
Wm. S. Levering,
Clement W. Smith,
Thomas S. Stewart.

*On Cabinet of Minerals and Geological Specimens.*

Martin H. Boyé,
Isaac H. Conrad,
John F. Frazer,
F. Augustus Genth,
Henry Hartshorne,
John L. Le Conte,
B. Howard Rand,
J. Hamilton Slack,
Laurence Turnbull,
John C. Trautwine.

*On Cabinet of Arts, and Manufactures.*

James C. Booth,
Thomas Bickerton,
Samuel Broadbent,
Jacob R. Eckfeldt,
John M. Gries,
Edwin Greble,
J. Hall Rohrman,
F. De B. Richards,
James M. Somerville,
John Wallace.

*On Cabinet of Models.*

William H. Clark,
George W. Colby,
James Dougherty,
George C. Howard,
Henry Howson,
Benjamin Morison,
Clayton B. Rogers,
Charles J. Shain,
William Smith,
Andrew M. Spangler.

*On Exhibitions.*

John E. Addicks,
John Agnew,
George W. Conarroe,
James H. Cresson,
Owen Evans,
Joseph Harrison, Jr.,
Samuel V. Merrick,
John H. Towne,
Isaac S. Williams,
Thomas J. Weygandt.

*On Meetings.*

William B. Atkinson,
Henry Howson,
Washington Jones,
J. Vaughan Merrick,
Thomas S. Martin,
John F. Mascher,
John P. Parke,
B. Howard Rand,
Marshal B. Smith,
Laurence Turnbull.

*On Meteorology.*

Charles M. Cresson,
Owen Evans,
John F. Frazer,
James A. Kirkpatrick,
E. Otis Kendall,
Alfred L. Kennedy,
James A. Meigs,
Edward Parrish,
Theodore Poesche,
Ayres Stockly.